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THE GIRAFFE AT THE ZOO.

By FRANK E. BEDDARD, F.R.S.

THE plate illustrating this paper represents the young female giraffe which has recently become an inmate of the Zoological Gardens. Some years ago giraffes were among the most commonplace animals exhibited in that institution; they might almost have been said to be indigenous there, for they bred successfully and led a perfectly natural life. But about six years ago the last representative of the old state of affairs died, through sheer age, and in the meantime circumstances were conspiring to prevent the recruiting of the collection; hence for some years an *hiatus valde deflendus*. The conspiring circumstances appear to have been mainly a man and a fly. The man was the Mahdi, and the general turmoil in the Soudan and thereabouts due to his activity; the fly is the well-known tsetse. This latter animal is no more fatal to the giraffe than was the Mahdi, in itself; but giraffes were hunted upon horseback, and it is of the horse that the tsetse is so determined a foe. It is clear, therefore, that the young beast at the Gardens is a highly valuable acquisition, and it is to be regretted that so far no companion has been procured for her. It is, unfortunately, not only at the Zoological Gardens that the giraffe is getting near to extinction. Like most of the large game of Africa, the giraffe's days are probably numbered. The advance of civilization, so gratifying to the philanthropist and the trader, is a matter of abhorrence to the naturalist. We have seen in the last few years the practical disappearance of the quagga, the next to disappearance of the white rhinoceros; and all these great beasts are now retiring further and further away from contact with colonists, the retirement being naturally accompanied by diminished numbers. Yet the giraffe is stated to be well equipped for the battle of life by those who have studied it in Africa. To us it seems a somewhat ungainly beast, with an unnecessary length of neck and forelimb. The ungainliness is, perhaps, tempered by the beautifully conspicuous spots, which are especially sharply marked out in the animal at the Gardens, the representative, as it is, of a variety of the more abundant, or, at any rate, the more usual form. Unlike the stag in the fable, the giraffe can trust to its beauty spots as much as to what might be considered the more useful features of its organization. Like the individual who was unable to see the wood for its trees, an eminent observer is stated to have been quite near to a giraffe and unable to detect it on account of its spots; the dappled appearance due to these suggesting a broken stream of sunlight falling upon a withered tree trunk, the tree trunk being clearly the animal's stout neck. A recent traveller in Africa, Mr. Scott Elliot, makes an ingenious suggestion about the giraffe's neck which we have not seen put forward elsewhere. It is commonly held that this disproportionate part of the body is important to the creature as a natural ladder whereby to reach the tender twigs of a tree inaccessible to the common herd of bush-living ruminants; but Mr. Elliot points out with some acuteness that in the grass-covered plains of eastern tropical Africa, with scattered trees, there are other beasts with long necks which do not depend upon the trees for their nourishment; there is, for instance, the ostrich, longest necked of birds. By means of this long neck the giraffe can take a wide survey of his environment, and perhaps detect a lion or pard with prying head in time to retire with success—"what time she lifteth herself up on high and scorneth the horse and his rider." The giraffe, in fact, is fairly fleet, though its progress is not elegant, having, indeed, been compared to that of a frog. The neck, which was so inconvenient a feature in conveying the animal to the Zoological Gardens, is apparently, so far as giraffes are concerned, quite a recent acquisition. It is true that extinct forms of giraffe, differing only specifically from the animal which we are considering, formerly existed in Asia, and even in Europe, so that the diminution of giraffes is not a thing of yesterday; but the earlier creatures which have been referred to this group of hoofed animals had comparatively short necks. The *Samotherium* and *Helladotherium*, whose habitats are recorded in their names, were giraffes to all intents and purposes, but with necks on the plan of the ordinary Ungulate. It may be that in this lengthening of neck we can trace the gradual change from a browsing, plain-living animal to the present bush-frequenting camelopard.

In its present situation the giraffe cannot exercise its capacity for plucking by the help of its long extensile tongue the twigs of the few trees that are scattered through its enclosure, its predecessors having done what could be done in this direction; but the customary method of feeding is kept up by means of a very high manger.

We have seen the important place that the giraffe occupies in the Zoological Gardens, which is emphasized by its tenancy of an entire house to itself; what is its place in nature? Curious though it may seem, it is not far off in the scale of nature from its near neighbour the

apoplectic hippopotamus, and like it occupies (in more senses than one) a very high place. Both animals are, in fact, the only representatives alive of distinct families; the hippopotamus leans towards the pig, the giraffe is a deer with a dash of antelope. In its general structure it is not markedly different from either. Its horns are most interestingly intermediate. They are but small, considered as functional horns; but the smallness in size is made up by numbers, for the giraffe has three horns, one in the middle and one on each side. The latter are bony projections covered with a persistent skin. In being bony projections they are like the horns both of deer and antelopes. In being covered with hairy skin they are like deer, whose "velvet" everyone knows; but in the fixedness of this velvet, which is not shed, the giraffe is an antelope.

PARASITIC LEAF-FUNGI.

By Rev. Alex. S. Wilson, M.A., B.Sc.

ABOUT the time when the blackberries are ripe, after a short search one can generally find a bush the leaves of which have a paler appearance than ordinary; closer inspection shows the under surfaces of the leaves flecked here and there as if with specks of soot. With the aid of a pocket lens each speck is seen to consist of tufts of little club-shaped bodies, and if we scrape some off, mount them on a slide, and place it under the microscope, we see that they are cylindrical cells, each made up of from three to eight joints, and supported by a short stalk. Their form is so characteristic that, once seen, there is no difficulty in recognizing it again. These are the telutospores of the bramble brand (*Phragmidium violaceum*), a parasitic fungus belonging to the order *Æcidiomycetes* (or *Uredines*), all of which inhabit living plants.

The leaves of various species of mint are in autumn often dotted over in like manner with dark-coloured spots, due in this case to the telutospores of *Puccinia menthæ*, each composed of two joints of hemispherical form. By this two-celled character the Puccinia genus is distinguished from Phragmidium, which has telutospores usually consisting of more than three joints. On the meadow-sweet a brand, *Triphragmidium ulmariæ*, occurs, having three-celled telutospores; those of the brands which affect the bean, pea, clover, and lady's-mantle, species of Uromyces, are unicellular. *Gymnosporangium* (*Rostelia*) growing on junipers has them two-celled, closely packed, and embedded in gelatinous substance: they are prismatic, and form a compact layer in Melamspora infesting the leaves of the willow and sunspurge; and the species of Colesporium living on the colt's-foot and eye-bright have four-celled telutospores united to form a compact, waxy stratum, surrounded by a gelatinous mass. The characters presented by their telutospores thus form the basis of the classification usually followed in this group of fungi, the spores of which, indeed, constitute the principal feature.

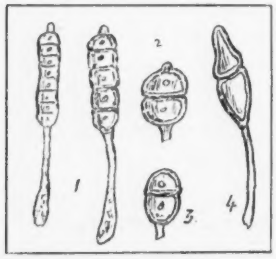


Fig. 1.—Telutospores. 1. *Phragmidium violaceum*. 2. *Puccinia menthæ*. 3. *P. violarum*. 4. *P. graminis*.

Telutospores are resting or winter spores; only in a few cases are they capable of immediate germination. The name, derived from *telos*, "end," indicates that their production is regarded as completing the life cycle of the fungus. Unlike other spores, which on germination give rise to a branching mass of thread-like cells known as a mycelium, which is really the vegetative body of the fungus, a telutospore only develops a short filament or promycelium, on which arise small reproductive cells, the sporidia; the latter are able at once to germinate and form mycelia.

Minute yellow streaks may be observed during the latter half of the year on the leaves of all our common grasses, especially on the lower leaves, by anyone who will take the trouble to look for them. On examining these with the pocket lens they are found to be chinks in the epidermis of the leaf filled with orange-coloured dust. Under a microscope of low power, with direct light, a small piece of grass-blade so affected presents a charming appearance. The dust is seen to be composed of orange-red globules, having a waxy lustre or bloom, reminding one of artificial fruits, and forming a splendid contrast to the bright-green chlorophyll grains of the leaf. With careful focussing under a higher power, minute projections studding the surface of the spores become visible, giving them a bristly appearance. These are the summer or uredospores of a parasitic fungus now designated *Puccinia rubigo vera*, one of the corn-rusts which occasionally inflict so much damage on cereal crops. *Puccinia graminis* injures the wheat; allied species occasion the orange and scarlet patches of rust seen on the rose, barren strawberry, eye-bright cow-wheat, sow-thistle, groundsel, thistle, harebell, nightshade, dog's-mercury, and many other native plants. The name uredospore (*uro*, "I burn") has reference to the conspicuous disfigurement and often burnt appearance of leaves attacked by these fungi. Unlike telutospores, the uredospore germinates at once if placed on a suitable host, and gives rise to a filament which penetrates the epidermis and develops into a mycelium, extending through the intercellular passages of the leaf. Uredospores commonly appear somewhat earlier in the season than telutospores, though the two often grow together.

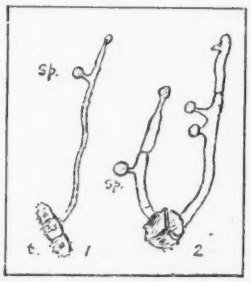
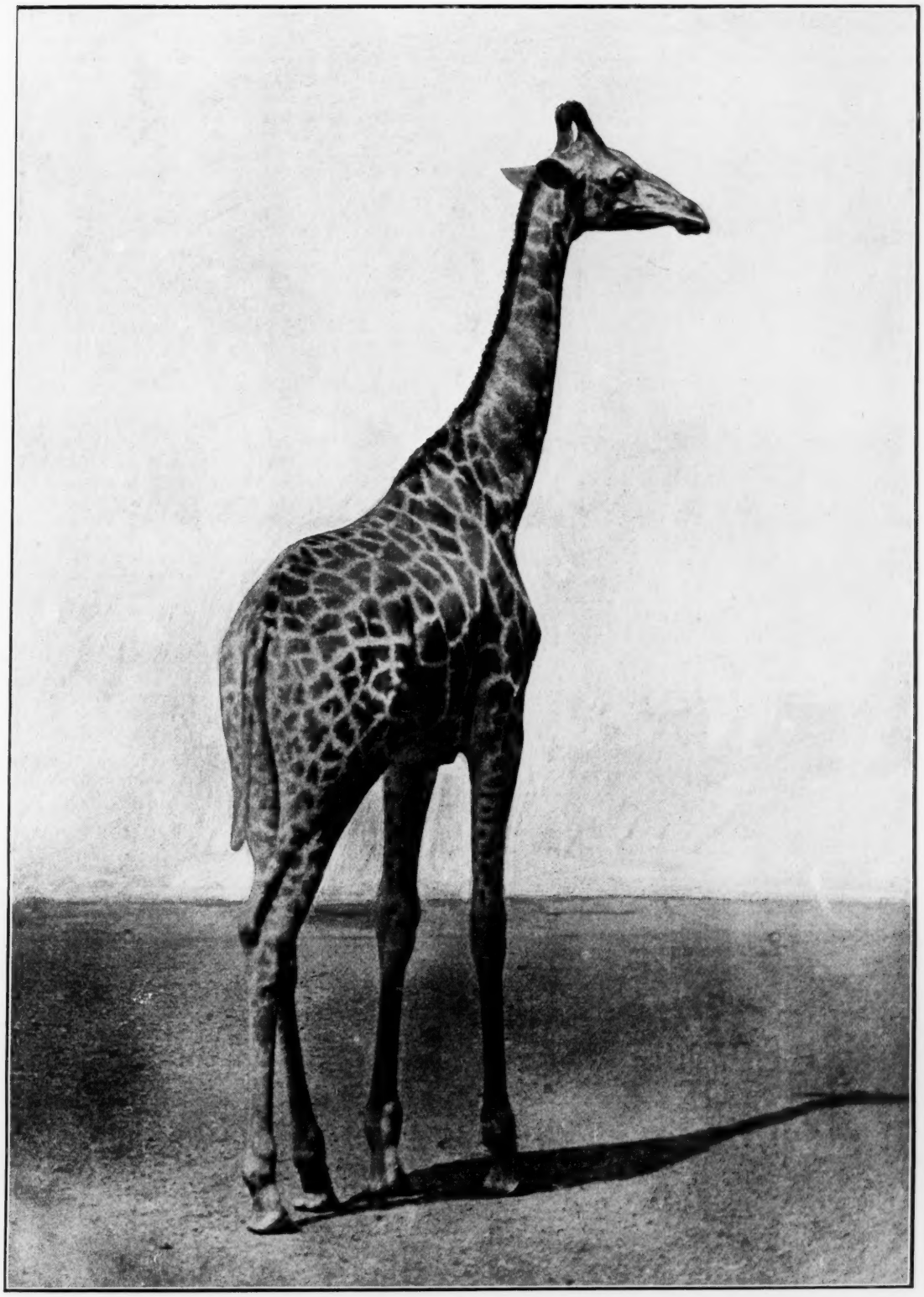


Fig. 2.—Germinating Telutospores, with promycelia and sporidia (sp.). 1. *Phragmidium*. 2. *Triphragmidium*.

On gooseberries our readers may sometimes have remarked a bright yellow spot about the size of a sixpence. Similar spots occur on the leaves of gooseberry and currant bushes. The lens shows that they consist of a number of small round openings full of orange powder; these are the cluster-cups and æcidiospores of *Æcidium grossularia*. An exceedingly common species, *Æ. compositarum*, is found on the lower surface of the colt's-foot leaf, a plant abundant on every railway embankment. Plants may possess more than one species of parasite; on the colt's-foot there also occurs a species of Colesporium, and nearly a score of different fungi are stated to take up their quarters on the leaves of the nettle. Each species of æcidium confines itself, as a rule, however, to plants of a particular family, or even selects its hosts from a single species; thus the æcidia of the berberry, hawthorn, honeysuckle, Scotch fir, mountain ash, anemone, buttercup, nettle, primrose, violet, willow-herb, bedstraw, dock, and many other plants are all different and belong to distinct species. Seen with the lens the cluster-cups present the appearance of a group of



FEMALE GIRAFFE AT THE ZOOLOGICAL SOCIETY'S GARDENS, LONDON.

From a Photograph by Mr. GEORGE WITHERBY.

XUM

XUM

miniature volcanoes. At first the æcidium fruit is a small spherical body formed beneath the epidermis of the leaf whereon it grows, which it ultimately ruptures; the æcidium itself, when ripe, bursts, and the yellow spores are discharged. The section of an æcidium shows a cup-like cavity with the spores arranged in vertical rows like short strings of beads; they are developed by budding, and become detached in succession. Externally the æcidium is in most species invested by a membranous envelope, the peridium, usually cup-shaped, but occasionally, as in the cluster-cups of the pine, prolonged into a tube. The peridium may open irregularly or split up in a definite manner, giving its margin a toothed appearance. An æcidiospore can germinate when sown on a suitable host. The cluster-cups appear earlier in the season than the uredo or telutospores, and are very often associated with smaller cups called spermogonia, which appear on the upper surface of the leaf (Fig. 5, 1 spm.), from which issue minute spermatia, which have never been known to germinate, and are therefore generally regarded as male reproductive cells.

All the three kinds of spores above described, it must now be explained, are produced in succession by some of the Uredines on the same mycelium. The Puccinias of the mint, primrose, violet, goat's-beard, and onion develop all three forms; teluto, uredo, and æcidiospores occur on the same plant. Had we examined the bramble Phragmidium earlier in the season we should have found, not the many-celled telutospores, but unicellular uredo or æcidiospores. The rose rust, *Ph. subcorticum*, and that of the barren strawberry, *Ph. fragariæ*, in like manner bear three kinds of spore on the same host. The rusts of the knot-grass, beet, geranium, and valerian, caused by species of Uromyces, also possess spores of three kinds. Others, like *U. alchemillæ* and *U. rumicis*, have teluto and uredo but no æcidiospores. Only telutospores are known to be produced by the Puccinias parasitic on the gout-weed, speedwell, mallow, harebell, and saxafrage. Uredospores are wanting in the Puccinias of the ragwort and earth-nut; telutospores are absent in the rusts of the figwort and fern, while neither the uredo nor telutospores are known which correspond with the æcidia of honeysuckle, meadow-rue, and gooseberry. The three kinds of spore are not formed simultaneously; further observations may therefore be expected to reduce the number of these exceptions. Before it was known that a cluster-cup, a rust, and a brand might be merely successive stages of the same fungus, specific names had been assigned to each of the forms, with the result that some of these parasites have three names; and this inconvenience is still unavoidable in cases where the connection between the different stages has not yet been demonstrated.

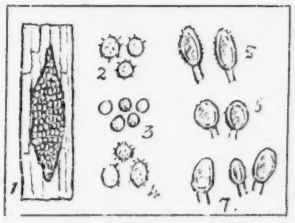


Fig. 3.—Uredospores. 1. Portion of grass blade, with rust. 2. Spores of bramble rust. 3. Spores of barren strawberry. 4 and 5. Spores of corn rusts. 6. Spores of rose rust. 7. Spores of thistle rust.

But what invests this group of fungi with peculiar interest is the fact that many of them spend their first or æcidium-bearing stage on a different species of host-plant from that which they inhabit at a later period of their life history, when they develop uredo and telutospores. Thus there are several kinds which produce æcidia on the leaves of firs and pines, and then migrate to plants of the heath order. To this changing of hosts the name Heterœcism (*heter*, "other"; *oikos*, "house") has been given. Analogous phenomena are observed among animal parasites. The same organism which occasions "measles" in pork, afterwards gives rise to the tapeworm in man; the tapeworm of the cat is but a more advanced form of one that inhabits the intestines of the mouse; and the liver fluke of the sheep passes one part of the cycle of its development in the body of a pond snail. Farmers long suspected that the presence of berberry bushes in their hedges had something to do with the rust that destroyed their wheat. This idea was verified by the discovery that *Puccinia graminis* is merely a later stage in the development of *Æcidium berberidis* which infests the berberry. As the alternation of generations was first traced in this species, it is the example of heterœcism usually given in text-books, but a similar connection has been made out in many other instances. The cluster-cups of the Scotch fir belong to the same Uredine which bears teluto and uredospores on the groundsel; those of the colt's-foot correspond to telutospores on the meadow grass of *Puccinia poarum*: *Æcidium urticæ* of the nettle develops uredospores on species of Carex; the æcidium fruits of *Gymnosporangium cancellata* occur only on the leaves of the mountain ash and other Pomaceæ, the telutospores only upon those of species of juniper. The æcidium of the buckthorn is related in the same way to *Puccinia coronata*, not uncommon on grasses. Again, the æcidia of the orchid, onion, dock, and dandelion appear in their uredo forms on various grasses and sedges, while the parasites of certain Composites seem to migrate to other plants of the same order. The corn rust, *P. rubigo vera*, turns out to be the second stage of an æcidium that grows on the leaves of Anchusa and other plants of the borage family.

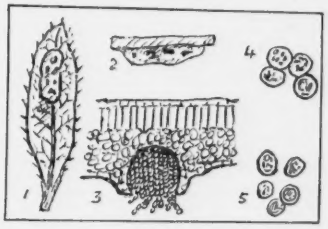


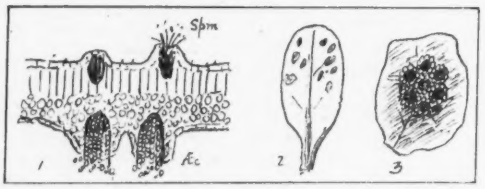
Fig. 4.—Æcidia. 1. Leaf of berberry, with cluster-cups. 2. Side view of group of æcidia. 3. Leaf of sunspurge spotted with *Melamspora euphorbiæ*. 4. Cluster-cups of bedstraw seen with lens.

From these examples it will be seen that in fungi of this description each generation of each species has its own form of fructification and its own peculiar host-plant. The brands of the mint and bramble are not heterœcious, but produce all three sorts of spore on the same host, or even on the same mycelium; the Uredines of the honeysuckle, meadow-rue, and gooseberry, of which only the æcidium forms are known, are likewise restricted to one species of host. In this country *Æ. grossularia* only produces æcidiospores; telutospores are stated to have been observed on the gooseberry itself on the Continent. Should this be confirmed, it would appear that the fungus in question is confined during its whole existence to the same plant, and does not, therefore, possess the heterœcismal character.

In the life history of one of these migratory fungi we have then the following phases:—The earliest form inhabits the leaves of a plant such as the berberry, where it exhausts its energies and completes its career by the production and discharge of the æcidiospores; the latter are incapable of germinating on the berberry, but on being transferred to wheat, at once germinate and form a mycelium which develops the uredo and telutospores. The

uredospores continue to propagate the uredo form of the fungus indefinitely upon the wheat, but the telutospores or sporidia arising from them will only grow mycelia if sown on the leaves of the berberry.

In not a few instances these relationships have been established by direct experiment. Dr. C. B. Plowright succeeded in producing æcidia on the hawthorn and mountain ash by infecting their leaves with telutospores taken from the juniper, and on the nettle with telutospores from a species of Carex. Conversely, with æcidiospores from the nettle he obtained the uredospores of *Puccinia caricis* on Carex, and spores from the colt's-foot cluster-cup placed on the meadow grass developed the uredo form of *P. poarum*. The æcidium of the berberry gave rise to *P. graminis* on grass, and berberry leaves infected with telutospores from the latter developed æcidia of the usual form. Check plants which in these experiments were not inoculated yielded negative results; the possibility of



error was thus eliminated. It may therefore be taken as conclusively proved that many of these leaf fungi exist in alternate generations as parasites on distinct plants, with forms so unlike that the successive phases in the life cycle of one and the same fungus were for long regarded as different species and classified in separate families. The brilliant orange and scarlet tints exhibited by so many Uredines are due to the presence in their cells of drops of highly-coloured oil. They differ from the Peronosporeæ in their septate mycelium, and are less destructive, as the mycelium does not extend through the entire body of the host, but the damage is usually restricted to the small affected areas of the leaf. Sexual reproduction has not been observed in the Uredines; there are, however, grounds for the belief that a process of fertilization really takes place, but the consideration of this question must be reserved for another occasion.

DAY-FLYING MOTHS.

By L. N. Badenoch.

A POPULAR division of the *Lepidoptera*, or scale-wings, in England, is into butterflies and moths; the former being termed *Diurni*, the latter *Nocturni*. In most Continental languages one principal word serves for the two great Lepidopterous groups. Thus, *papillon*, in French, may stand for either a butterfly or a moth, and they are distinguished respectively as *papillon de jour* and *papillon de nuit*.

But since, in fact, many of the species of the nocturnal *Lepidoptera* are day-fliers, and, *vice versâ*, not all the diurnal *Lepidoptera* fly by day, the habits of these insects do not seem to prove a good basis for separation. In order to avoid the misconceptions produced by the terms "diurna" and "nocturna," Boisduval, a French entomologist, proposed to substitute *Rhopalocera* (club horns) for the butterflies, and *Heterocera* (different horns) for the moths.

At first glance few distinctions appear more happy than this—few classifications more natural. It was no sooner announced than it was recognized as a most convenient arrangement, and it quickly came into general use. It is founded on the structure of the antennæ. A marked thickening towards the end almost universally characterises the antennæ of the *Rhopalocera*. Such being the case, it is undoubtedly a character of primary importance. But a certain family of moths (*Sphingidæ*), by their antennæ thickening towards the end, though terminating suddenly in a point, bring the two groups into near relationship, and lessen their value, while the most interesting *Castniidæ* and *Uraniidæ* (of which more anon) so intimately connect them that these families have sorely perplexed systematists as to whether their rightful position was with the one group or with the other.

In a word, though we may speak of Rhopalocerous and of Heterocerous characters, there is no one character which infallibly severs the two divisions. The more intimate our knowledge of animal forms, past and present, becomes, the more our demarcations give way. As we arrive at a true conception of the relations of animals we realize the closer approach of the different groups, until we perceive an almost continuous chain.

Let us glance at the curious and abnormal collection of pretty insects, *Castniidæ*, which, in some respects, combines the characters of both Lepidopterous divisions, but in modern opinion has most affinities with the moths. Linnæus and all the writers of the last century regarded the species of the genus with which they were acquainted as butterflies, including them in the great group *Papilio*, on account of the clubbed structure of their antennæ. At the beginning of the present century, when this group was broken up, the genus *Castnia* was established, though Fabricius still retained it among the butterflies. But when the antennæ are carefully examined, they do not exhibit the real Rhopalocerous structure. In like manner, the

Thalaura Phipheus (Madagascar). Two-thirds natural size.

Castnians differ from other groups of Heterocerous *Lepidoptera* in the complicated arrangement of the veins of the wings, and in various ways.

In general appearance they vary much, but, typically, they have large wings, with loose and remarkably large scales, and a position in repose deflexed or incumbent, being furnished with a wing-guide or guides; and the antennæ, though club-like at the tip, are generally long and more or less supple. All these characters are constant, and are Heterocerous characters. As a rule the head is broad, and the body large and somewhat pointed. The Castnians resemble butterflies in this particular, in their evidently diurnal habits, as evinced by the brilliancy

of their colours. Numerous species are reckoned within their number, many of large size, and generally adorned with beautiful colours, a rich effect heightened by the metallic gloss of the prominent scales with which most of them are covered. In respect of colour the sexes may differ widely.

Turning to their preparatory stages, the larvæ are endophytous, boring, with strong mandibles, the interior of stems and roots of cacti, of orchids, and other plants—a habit which, though found in butterflies, is very exceptional. Likewise, they are provided with the ordinary horny piliferous spots or tubercles that characterize Heterocerous larvæ, and have a horny anal plate, whereas butterfly larvæ rarely possess these warts. In keeping with all Heterocerous borers, the pupæ are supplied with minute spines on the hind borders of the abdominal joints, affording the pupa power of moving in the tunnel bored in the tree, and assisting it out of its cocoon.

The *Castniidæ* are essentially proper to the warm equatorial regions; their geographical range, in fact, extends only to Mexico and Central and Southern America, finding their greatest development in Central America and Brazil. The few *Castnioides*, or species of *Megathymus*, known, inhabit the southern portion of North America, hailing from the Southern States, from Florida, and from Arizona. The genus *Synemon* appears to represent the *Castniidæ* in the vast continent of Australia.

Of these aberrant forms *Megathymus yuccæ*, the Yucca Borer, is one of the most interesting. Although placed with the *Castniidæ*, it has none the less given great trouble to systematists, having been bandied from the butterflies to the moths; and, it must be owned, some still regard it as a genuine butterfly. This species is common in the Gulf States of America over extended regions, where its larva commits serious depredations of the nature that its popular name implies.

It is a dull-coloured moth, and rests with wings elevated—thus differing from the typical *Castniidæ*—its antennæ generally directed forwards; also in smaller wings, in smaller closer scales, in unarmed hind-wings, and in stiffer, relatively shorter, antennæ, it diverges in character from the *Castniidæ*. Its flight, which is diurnal, is an extremely rapid darting motion as it passes from plant to plant, principally in open spots. During April and May, and earlier, it may often be seen in the morning where the yuccas abound, darting hastily about after its customary fashion, on laying thoughts intent; and as it pauses for a few seconds at one place, it fastens an egg to some portion of a leaf. The eggs are laid singly, though more than one may be put on the same leaf. The larva, which is reddish brown, with a black head, shelters itself in a web between some of the young terminal leaves. Usually it starts proceedings near the tip of a leaf, working gradually downwards, eating the while, and rolling and shrivelling the blade as it goes. It lives thus among the leaves till about one-fourth grown, when it enters the trunk, commencing the devastation for which it is famed. Along the axis the trunk becomes bored and tunnelled out into a cylindrical burrow, wherein the larva makes its home, extending often to two or more feet below the ground, and at its upper end lined with silk, generally intermingled with a white, glistening, powdery material, soapy to touch, and analogous with that of Hymenopterous and many Homopterous larvæ. At what stage of larval development this powder is secreted is not known, but the full-grown larva is always covered with it more or less copiously, and doubtless it protects the invader against the mucilaginous liquor which the yucca freely exudes on maceration.

The funnel-like tube outside the burrow, made by the twisting and webbing together of the tender leaves, when partially devoured, is quite characteristic of the larva of *Yuccæ*. The tube is, indeed, built and extended often several inches beyond the trunk or stem; from it the builder, especially when young, emerges to feed, and the small amount of matter besides silk used in its construction—the remnants of leaves and such-like substances—have been obtained and worked into the exterior from the outside. Pupation generally takes place at the top of the burrow, just below the funnel-like projection, but without the preparation of a well-formed cocoon. The pupa is of a brown-black colour, and, like the mature larva, is more or less densely covered with a white powdery bloom.

Urania fulgens (Central America). Two-thirds natural size.

It has long been a problem with systematic writers what is the true situation in nature of the highly interesting group of insects *Uraniidæ*. The day-flying habits of the insects, together with their airy forms and the extraordinary brilliancy of their colours, naturally led to their being at first classed among the *Rhopalocera*, but later acquaintance with their transformations proves them to belong to the Heterocerous division of the order.

They are among the most richly ornamented *Lepidoptera* of that very brilliant order. It would be difficult for art to effectually represent the changeable and resplendent golden green of the numerous bars which contrasts with the velvety black of the wings, and varies with every change of light. The posterior wings are prolonged into a single elegant pointed tail, closely resembling that appendage in many swallow-tailed butterflies; or there may be present at the hinder extremity of the wings no fewer than three distinct tails. The typical species of these superb insects are natives of tropical America, where they fly so high, and with such amazing rapidity, that it is almost impossible to catch them, and the only way, therefore, to obtain good specimens is to rear the caterpillar.

Urania boisduvalii, which inhabits Cuba, may be considered as one of the most beautiful *Lepidoptera* known. It attains an expansion of wing of from four to four and a half inches, with an undulated rim, the hollows of which are more or less sparsely tipped with white; otherwise its colours are velvety black and green. While the black of the superior pair of wings is relieved with golden green transverse lines, and their under side is nearly all black, with transverse lines of a bluish green, on the black of the inferior wings we note a longitudinal broad discal green

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band, a mark easily distinguishing this beautiful species from all its congeners.

On approaching from the sea any open sandy shore in the Isle of Cuba a copse wood is perceived, above the coral reefs, forming a close and nearly impenetrable belt, maybe ten or twenty yards wide, and composed of almost one kind of tree, of aspect strange to the European eye, the *Coccoloba uvifera*, the so-called *Uvero* of the Spaniards. Immediately behind this belt an immense variety of vegetation grows in the parched sand, the plant of chief interest to us being that technically titled *Omphalea triandra*.

This, the Cob or Hog nut of Jamaica, the *Avellano* of the Island of Cuba, sometimes reaches the dimensions of a tree fifteen feet high. The part that concerns us is the leaves—great, thick, heart-shaped things of leathery texture, and a scabrous surface of a pale green; the young leaves and the leaves of the young plants, although of the same texture and colour, are of different form, being deeply incised.

During the heat of the day, on the upper side of the mature entire leaves of this tree the caterpillar of *U. boisduvalii* may often be discovered torpidly reposing, screened from the fierce rays of the sun within a thin transparent silky web. At night, no longer sluggish it quits its cover, greedily stripping *Omphalea* of its foliage, so that trees are left with scarcely a single leaf; nor is it inactive in the daytime when disturbed, but can run about quickly, and shows little affinity to the caterpillars of other diurnal *Lepidoptera*, which usually have a slow motion.

In February, and the ensuing months of spring and summer, the perfect insect deposits its eggs on the tender incised leaves, laying them singly. The young larva is of a pale green, with a yellowish head; but ere it reaches maturity its appearance undergoes considerable alteration. It is then about two inches long, and moderately hairy; and while the body varies in tint from a pale yellowish

Urania leilus. Two-thirds natural size.

green to a flesh colour, the head now is red, irregularly sprinkled with some black spots, and the prothorax of a velvety black. The head is polished and sessile. But these larvæ differ much from each other in size, marking, and colour, more so than ordinarily occurs with larvæ of the same species.

Eventually the larva spins an oval cocoon of dirty yellow silk, of which the threads are so few, and so loose, as to allow the inmate to remain visible through the meshes; within the cocoon it changes to pupa. The chrysalis is not at all angular, and, moreover, reposes in a horizontal position. Yet it agrees with that of most diurnal *Lepidoptera* in being rather gaily coloured.

The flight of the imago is truly diurnal, swift, always strong, and in starts. The interior of the island it does not seem to haunt, but may be found plenteously in gardens at a distance of two, and even three, leagues from the shore. But it is by far the most common near the sea, because there grows its favourite *Omphalea*. As a matter of fact, however, it prefers flitting about the leaves of the *Coccoloba uvifera*, unless when employed in depositing its eggs.

As the genus *Omphalea* is common in Brazil and Guayana, in all probability it affords pabulum to *Urania brasiliensis* and *U. leilus*, species whose habitats are Brazil and Cayenne and Surinam respectively: for, as MacLeay remarks, "the minor natural groups of *Lepidoptera* often keep very constant to the same natural group of plants." In a word, the gorgeous Madagascar *Chrysiridia madagascarensis*, the species of the East India isles, and many more, may likewise feed on leaves of seaside *Euphorbiaceæ*.

Remark the habit of these day-flying moths of performing migrations. The very beautiful *U. fulgens* migrates annually, from east to west, in August and September, across the Isthmus of Panama. Flights have been observed by a naturalist in the Isle of Caripi, near Para, in the Brazils, at Pernambuco, at Rio Janeiro, and in the Southern States; but he saw them nowhere so abundant as on the Amazons. From early morning till nearly dark the insects passed along the shore in amazing numbers, but most numerously in the evening, and mainly from west to east. Swainson, speaking of *U. brasiliensis*, a species almost the exact counterpart of *U. leilus*, states that he witnessed a host flying during the whole of a morning in June past Aqua Fria (Pernambuco), in a direction from north to south—not one deviating from this course, notwithstanding the flowers that were growing around; and though they flew near the ground they mounted over every tree or other high object which lay in their path; and it was impossible to capture a single specimen, so rapid was their flight. For three or four days they continued to pass in this manner. On the occasion of the flights over the city of Panama, in some cases the insects are attracted into houses by the light, so as to almost fill the rooms. At night they are accompanied by goat-suckers, and during the day by swallows and swifts, which probably destroy large numbers. As will be gathered, these migrations of *Urania*, though regular, are confined to comparatively narrow limits in the tropics.

THE SPECTROSCOPY OF ARGON.

Translated from the French, with Additions,

By T. L. Alger, LL.D., Ph.D.

MR. CROOKES found, on examining this gas with a very powerful spectroscope, that it gives, like azote, two distinct spectra, according to the intensity of the induction current employed, but that these two spectra are both constituted of fine lines.

He used ordinary Plücker tubes having a capillary part in the middle, which are quite suitable for this particular investigation.

At the commencement, the bands of azote are always seen, even with argon which is supposed to be perfectly pure, but they disappear at the end of a certain time.

At the pressure of three millimètres the most brilliant spectrum is obtained, and in this case the light is red. On diminishing the pressure and placing a Leyden jar in the circuit, the colour of the discharge is seen to pass

from a beautiful blue to a steel blue, and then we get the second spectrum.

The first is composed of eighty lines, the second has one hundred and nineteen, and there seem to be twenty-six lines in common.

The analogy that argon presents with other simple gases lies in the hypothesis that it is itself considered to be a simple body.

Mr. Ramsay has also been able to detect the presence of argon and also of helium in clèveite, a mineral discovered by Nordenskiöld, and found to be formed from oxide of uranium, uranate of lead, and other rare minerals. Except in a meteorite in Augusta County, Virginia, U.S.A., helium had only been observed in the spectrum of the sun.

M. Bouchard, again, has found that the lines which are characteristic of the spectra of argon and of helium exist in the spectra of the mineral waters of Cauterets.

M. Deslandres has also observed in clèveite another line which is found in the solar spectrum, and which bids fair to announce to the scientific world the presence of a new element common to the atmospheres of the sun and the earth.

Lastly, M. Berthelot, in his study of the spectra of fluorescence, has discovered, with argon charged with the vapour of benzine and submitted to moderate magnetic action under certain conditions which appear to correspond to a particular state of equilibrium, that this absorbed vapour does not pass away even after a considerable time has elapsed. First a violet tint is obtained with a sprinkling of fiery red, then a beautiful green fluorescence which is visible in broad daylight even at a distance. The clearest, most characteristic, and most brilliant line is green; of the rest, almost as brilliant are a yellow line and two violet lines, the latter less visible than the others; but there is one line, the last of the series, which can only be seen in total darkness. These lines correspond to the brilliant lines of argon considerably rarefied.

The appearance of the lines due to fluorescence at atmospheric pressure seems to indicate the existence of a combination of hydro-carbonate of argon of the same order as hydrocyanic acid.

From certain lines coinciding with the lines of the vapour of mercury rarefied, M. Berthelot concludes, that he has produced a complex equilibrium—or, rather, a condensed compound, originating when the mercury and the elements of benzine come between at the same time as the argon.

ALKALI-MAKING BY ELECTRICITY.

By C. F. Townsend, F.C.S.

THERE is hardly a single industry, from the cottage laundry to the mill where the paper is made on which this article is printed, in which alkali, in some form or other, is not used in large quantities. Under the term "alkali" we include ordinary washing soda, and soda ash, caustic soda, and caustic potash. Until the end of the last century all the alkali used by the world was obtained from vegetable or mineral sources. Of the former, potashes or the ash obtained by burning wood or vegetable matter is still a product of commercial importance, being used in the manufacture of soft-soap. Barilla, which is the ash of a plant that grows plentifully on the salt marshes of Spain and the neighbouring parts of France, was of considerable importance in soap-making and kindred industries fifty years ago; but a very small quantity is imported into this country at the present day. Kelp, which is obtained by burning seaweed on the coasts of Scotland and Ireland, contains a small proportion of soda, but is chiefly valuable as the source of iodine and bromine. As regards mineral sources, soda is obtained from the various deposits of alkali in the more tropical regions of the world.

It was not until just before the French Revolution that a process was devised for making alkali by artificial means. The discovery came about in this way. Some years previously it had been discovered that the base of common salt was the same as that of mineral alkali, and in 1775 Scheele, the poor apothecary's assistant who did more for the progress of science than almost any man before or since, had found that litharge would convert common salt into caustic soda. About this time the French Academy of Science offered a prize for a method by which salt could be converted economically into soda. The successful competitor was Nicolas Leblanc, and his process, with a few modifications, is in use at the present day. Nicolas Leblanc, like all the great benefactors of humanity, got little out of it himself. He secured a patent and commenced operations at St. Denis. His patron, the Duke of Orleans, however, was executed in 1793, and Leblanc's works were closed; whilst in 1794 a decree of the Committee of Public Safety deprived Leblanc of his patent for the benefit of his country, the magnificent sum of six hundred francs being awarded to him by way of compensation. The works were restored to him in 1801, but his capital was gone and he was unable to make headway against competitors who were using his invention. In 1806 a committee reported on his case, but the sum awarded to him was so trivial that Leblanc, in despair, committed suicide.

In converting common salt into caustic soda its atom of chlorine must be replaced by the elements of water, and carbonic acid must be added to this to produce washing soda or carbonate of soda. What is ordinarily called carbonate of soda is the bicarbonate, which contains twice as much carbonic acid as washing soda. In the Leblanc process the salt is first treated with sulphuric acid, which causes an interchange, the elements of sulphuric acid taking the place of the chlorine to form sulphate of soda or Glauber's salts, whilst the chlorine is carried off in the gaseous form as hydrochloric acid. This acid is now condensed in water instead of being allowed to escape into the open air to blight the whole surrounding country as it used to do, and in its unpurified form is called muriatic acid or spirits of salt. From this acid the chlorine is recovered and passed through chambers containing lime to make bleaching powder. The sulphate of soda is mixed with chalk and fine coal and heated in a revolving furnace. In the end this produces a solution of carbonate of soda, and the sulphur in the tank waste is nearly all recovered. To make the soda crystals used for washing clothes this is evaporated down by the waste heat from the furnace. If soda ash is required, a much stronger heat is applied to deprive the crystals of the water they contain; and if caustic soda is wanted, the solution is boiled with lime.

For many years the Leblanc process had the whole field to itself, but now it has a hard struggle to compete successfully with the ammonia soda process. The principle of this method is said to have been known since 1822, but although many worked at it the engineering difficulties proved too formidable, and it was not until about 1863 that the problem was solved by a Belgian chemist named Solvay. For many years after that the process did not seem to gain much ground, but since 1872 it has been making great strides, so that by this time nearly as much alkali is made by the ammonia process as by that of Leblanc. The principle of the ammonia process is very

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simple. Ammonia and carbonic acid are blown through brine, and bicarbonate of soda, which is comparatively insoluble in water, falls to the bottom. From this bicarbonate, soda ash, soda crystals, or caustic soda are made. The weak point about the ammonia process is that all the chlorine, forming more than half the weight of the salt used, is wasted. If it was not for this, the Leblanc process would have been defunct long since.

Until recently all the sulphur of the sulphuric acid used in the Leblanc method was thrown away to form the filthy heaps of tank waste which disfigure the country and poison the air in the alkali-making districts, but all this is recovered now by a method described in KNOWLEDGE a few years ago.

By whatever means we accomplish the separation of the chlorine from the sodium in common salt, all that we have to do is to supply the energy necessary to effect the change. Heat, the attraction of the chemical atoms for one another, and the electrical current are the different forms of energy. In the Leblanc process the first is used; in the ammonia process the second; and in the latest method the third form of energy is brought into play. In pumping water up to a reservoir on the top of a hill the work done will be the same whether we employ a steam engine, a windmill, or a hand pump; but the amount of power expended will depend on the efficiency of the pump. A pump with leaky valves that let half the water back again every time the piston is moved would require twice as great an expenditure of energy as a properly constructed machine. It is just the same in manufacturing chemistry. An ideal method on paper may prove very unsatisfactory in practice. Now, the electric current is the ideal way of applying energy for effecting chemical changes, although in practice we have been able to apply it very little at present. When a current of electricity is passed through a solution of common salt the effect produced on the chemical atoms is exactly similar to the "ladies' chain" in the dance known as the "lancers." All the sodium atoms commence to travel in one direction and all the chlorine atoms in the other, joining hands as they meet. Instead, however, of moving in a circle, as the dancers do in the "ladies' chain," the atoms move towards the two poles or ends of the conductors along which the electrical current reaches and leaves the solution. The chlorine travels towards the positive pole and the sodium to the negative pole. When they reach the poles the atoms are set free, so that from one pole the chlorine gas is given off and from the other sodium, which combines with elements of water to form caustic soda. If this action went on perfectly the electrical process would supplant the others in a very short space of time. Unfortunately, however, the sodium and chlorine atoms have a strong tendency to join hands again after they have been separated; and although there are other difficulties that are too technical for us to enter into here, nearly the whole of the work done in this field of investigation has been devoted to perfecting a means of preventing the atoms in the electrical dance from becoming partners again.

The principal contrivances that have been used for this purpose are porous partitions or diaphragms extending across the middle of the cell containing the solution of salt. The amount of ingenuity that has been expended on these diaphragms has been very great, but none of them are really perfect. The recombination of the atoms is never entirely prevented, and, as we might expect, the diaphragm gets in the way of the electric current to some extent, so that a higher power is required to drive the electricity through the solution. The most successful of these processes have been the Greenwood and the Le Sueur, which is said to be used extensively in America and on the Continent, where water power is available to drive the dynamos that supply the electric current. In the Hargreaves-Bird process, explained recently in a paper read before the Society of Chemical Industry, the difficulties of having a partition in the middle of the solution have been overcome in a most ingenious way. The brine is placed in the middle compartment of a vessel, divided into three parts by two diaphragms stretching across it. The diaphragms are supported on the outside by copper cloth, which forms the negative pole of the electric current. The two outer compartments, instead of containing brine, are filled with a mixture of carbonic acid and steam. As soon as the current begins to pass, caustic soda is given off at the copper cloth. The soda combines immediately with carbonic acid to form carbonate of soda, which dissolves in the water condensed from the steam and flows to the bottom of the partition, where it is drawn off. The chlorine gas passes off in the meanwhile through an opening in the top of the partition containing the brine, so that the partners, when once they have left the electrical dance, never come near one another again. By this process it is claimed that pure alkali and the strongest bleaching powder can be made at less than five-sixths the cost of the best of the older processes.

Besides the methods in which a diaphragm is used, other ways have been invented for removing the atoms from the neighbourhood of one another. In two of these, mercury forms the negative pole, towards which the sodium atoms travel. Instead of combining with the elements of water to form caustic soda, the sodium unites with the mercury. This quicksilver is kept in rapid circulation, so that as soon as the amalgam of mercury and sodium is formed it is removed from the vessel where the action is going on. The amalgam is treated in a separate vessel to recover the sodium in the metallic state, or it is run into water, where caustic soda is formed and the mercury is set free. One of these processes is known as the Castner-Kellner process, and the other has been devised by Mr. Claude Vautin. The last-named inventor is responsible for another ingenious method, in which fused salt is used instead of brine. The action goes on in a crucible kept hot by the electric current itself. The negative pole in this case is formed of a layer of molten lead at the bottom of the crucible. The sodium amalgamates with the lead in the same way as it does with the mercury in the process just described. In all the different methods the positive pole or electrode is formed of a rod or plate of gas carbon.

The non-technical reader may be inclined to regard this account of electrical alkali-making as somewhat dry, and of no particular interest to himself. It is really astonishing, however, to think of the vast revolution the introduction of electrical energy will effect in our industrial life. The whole conditions of life in the country will be changed. Water power will replace coal as the prime source of energy. The cohorts of factory chimneys, belching forth black smoke, which wanders over the sky in ever-increasing folds, like some evil genius just arisen from the bottomless pit to shut out the light of day from the workers, will disappear in a great measure. We are not blessed in this country with large rivers, but the water power of the tides running to waste round our coasts is enormous. The power of the tides running past Bristol is sufficient to drive all the alkali works in the kingdom half a dozen times over. The task of providing this water power might well be undertaken by our great maritime municipalities or county councils. All that is required is

to build large storage reservoirs at the level of the top of the tide. They would fill at the flood, and gradually run down to reservoirs on low ground, which would be emptied at the ebb. By means of turbines and dynamos this power could be transformed into the energy of the electric current, which would turn all the machinery in the city—if not in the whole county—besides lighting and heating the private houses and public buildings. Another important point is that our stores of coal are by no means inexhaustible. In fact, they are diminishing rapidly, and the most liberal estimate does not give our coal supply more than one hundred and fifty years' duration at the present rate of consumption. Long before that time the depths of the existing shafts will have to be increased so much that the cost of getting the coal will be very much augmented, and we shall be placed at a great disadvantage as compared with countries that have not drawn largely on their hidden store. If we are able to utilize the natural powers of the tides and rivers we shall be able to eke out our supplies of fuel to an almost indefinite extent, and the countries like our own with a large coast-line, round which run strong tides, will still lead the van in industrial progress.

OBSERVATIONS DE L'ÉCLIPSE TOTALE DU SOLEIL DU 16 AVRIL, 1893.*

M. DESLANDRES' report comes at a most appropriate time, and it will be the more welcomed since M. Deslandres has taken so prominent a part in that rapid advance in solar physics which has been so marked during the last few years, and since in the 1893 eclipse he attacked an entirely new department of the solar problem.

The report opens with remarks on the importance of eclipses, on the special conditions of that of 1893, on the necessity for using the photographic method in the study of coronal forms, and on the threefold character of the coronal spectrum. This is: first, continuous, from incandescent solid or liquid particles; second, bright line from the coronal gases; third, a feeble solar spectrum from reflected sunlight. M. Deslandres then speaks of his design to push his researches into the ultra-violet region of the coronal spectrum, and to determine the speed of rotation of the corona by the relative displacement of its lines east and west of the sun. This latter was not only a new investigation, but one of the highest importance; for if the corona be composed of a vast network of meteoric streams, its rate of motion would be much more rapid than if it turned with the sun.

The description of the instruments employed, and of the manner in which they were arranged, which follows next, is of great interest, but need not detain us now. The most striking detail was the use of a double polar heliostat in connection with three of the principal spectroscopes. The day of the eclipse was not particularly fine, the sky being by no means so clear as on the preceding days. However, twenty-seven photographs of the corona and of its spectrum were secured.

The photographs of the corona itself were obtained with three objectives of different ratios of aperture to focus, all mounted on the same equatorial. It is, M. Deslandres points out, practically impossible to fix what will be the best exposure beforehand; this combination of three lenses of very different relations gave him, however, a very wide range, and the greatest extension seems to have been secured with a telescope of f/a $12\frac{1}{2}$, an exposure of forty seconds, and a plate of medium sensitiveness. In all, seven plates were obtained with each of the three telescopes; but the last plate of each set was spoiled by the return of sunlight. The evaluation of the depth of deposit caused by the coronal light shows that for the region between 3′ and $9\frac{1}{2}$′ from the limb, the light equalled 0·18 of a "decimal bougie" placed at one mètre distance.

Comparison of the West African photographs with those taken in Brazil and Chili show no great change in the corona in the interval of time; but the comparison with those of earlier eclipses enforces the conclusion long since arrived at that the corona changes its form with the sunspot cycle. The threefold character of the coronal light, alluded to above, was again manifested: the bright line spectrum being strongest in the lower regions, the central region showing rather a continuous spectrum, and a feeble spectrum of reflected sunlight being given from remoter districts.

In spectroscopic work M. Deslandres was anxious to push his researches far into the ultra-violet, thus breaking up new ground. Five slit spectroscopes in all were employed, but two yielded no results. The other three gave good spectra, yielding the means for determining the positions of a large number of bright coronal lines, and the spectrum of the greatest dispersion enabled M. Deslandres to obtain the first determination of the speed of rotation of the corona. This, by far the most striking result of his work, and worthy of the strongest emphasis, gave a relative motion of the corona, east and west of the sun, of 6·8 km.; approaching, that is to say, the relative motion of particles rotating with the sun. This result would alone have been worth all the heavy labour M. Deslandres devoted to the eclipse; and though the more powerful spectroscope he designed for this research gave no result, and though we must hesitate to base theories on a single set of observations, as yet unconfirmed and not incapable of misconstruction, he is abundantly to be congratulated on the success obtained with his second weapon.

Other spectroscopic results were: the demonstration that the continuous spectrum, which forms the major part of the coronal light, is intensest towards the red, relatively to the light of the disc, and this is more marked the higher from the limb the point examined; that the dark line spectrum due to reflected sunlight cannot be detected at 5′ from the limb; and that the bright lines vary in different parts of the corona and at different heights, and do not usually correspond to known terrestrial elements. The concluding chapter of the report is one of especial interest. It is a review of the progress of our knowledge of the solar atmosphere up to the present day, with suggestions to which the long and careful consideration of solar problems has given rise in M. Deslandres' own mind.

The first point touched upon is the relationship of the periodic changes in the sun and its atmosphere, as, for example, the association of a particular type of coronal form with a solar spot minimum. The cause of this periodicity is still unknown, but M. Deslandres favours the sunspot theory of M. Faye, which regards sunspots as having analogies to terrestrial cyclones, and explains the differences in the surface speeds of the photosphere by great movements of gas in the vertical direction. For the corona an electric origin is favoured: M. Schaeberle's "mechanical theory," which is discussed somewhat at length, being irreconcilable with the results mentioned above as to the coronal rotation. In propounding an electric theory, M. Deslandres, as he points out, follows in distinguished footsteps, Tacchini, Fizeau, Secchi, Huggins,

* Par M. H. Deslandres. (Paris: Gauthier-Villars et Fils.)

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and many others having expressed opinions more or less in consonance with such an idea. (Dr. Brester's name is, by a slip, no doubt, given as Brewster.)

It would be entirely unfair to attempt to summarize in a few words the theory here expounded. It may suffice to say that M. Deslandres finds a very close analogy between solar and terrestrial meteorology; prominences, for example, being, according to him, the solar representatives of our electric storms.

A VERY EXTENDED STREAM OF SUNSPOTS.

THE years 1893 and 1894 were markedly the epoch of the sunspot maximum. 1895 showed a steep descent of the curve of spotted areas, and, indeed, on four days in April and three days in May of the current year the sun was entirely free from spots. Drawings of the solar corona of August, 1896, made at Bodö and Nova Zembla, added strong testimony of the near approach of the sunspot minimum. Nevertheless, on September 9th, 1896, a small solitary umbral spot was observed close to the east limb, which on the following day was seen to be the precursor of a group hardly surpassed in area even by the great group of February, 1892, and equalled by none in length. September 11th and 12th were cloudy; but on September 13th the photograph showed it well advanced on the disc, a sinuous length, a narrow band of almost constant breadth, with central and segmented nucleus and faintly continuous penumbra. To the north of the final spot of the riband, itself curved, there was a semi-elliptical ring of nebulosity with three or four small nuclei situated on the inner side of the ring, whose apse points north. In fact, the whole stream formed a series of curves whose concavities lay to the sun's equator. Little change was to be noted on September 14th and 15th, and by September 16th the great procession of spots was passing the central meridian, and its fair proportions were spread unaltered by foreshortening before our eyes. The sharply nucleated preceding spots of the group showed a tendency to shed indefinitely shaped nebulosities on their southern side, the centre of the stream was itself nebulous and ill-defined, and the regular following spots had broken on their northern edge into irregular penumbral patches. Thus though the band had quite lost the waved appearance which was its characteristic on September 13th, and the nuclei of the spots all lay towards the median line of the stream, a faintly spiral formation seemed indicated. But the chief feature of the group was now the form and method of segmentation of its separate spots. One type recurred again and again in many stages, and its form closely resembled the opening shells of a bivalve. The herald spot had lessened its distance from the great group very considerably. By September 20th the spots had aggregated to form three distinct groups, and as the stream had now nearly approached to the west limb its form and character could not be so easily recognized. On September 22nd only the final spots were to be seen on the sun's edge.

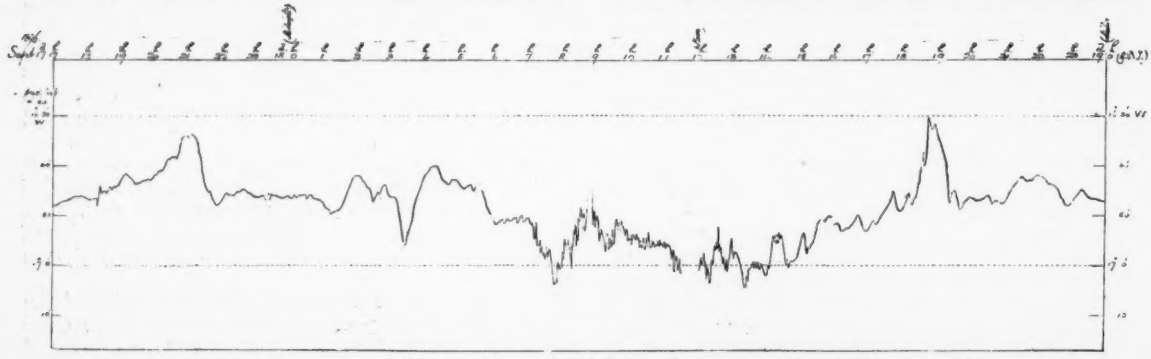
The accompanying plate will give, however, a better idea of the form and changes of the group than much verbal description. The photographs, which we are enabled to reproduce by the kind permission of the Astronomer Royal, were taken with the Dallmeyer photo-heliograph of four inches (three inches effective) aperture, and five feet focal length, of the Royal Observatory, Greenwich, on September 13th, 16th, 19th, 21st, and 22nd respectively. The primary image is enlarged fifteen times in the telescope itself, and has been further enlarged for reproduction twice more, so that the scale of the photographs here given is half an inch to a minute of arc, or about sixteen inches to the solar diameter.

The leading spot of the group on September 16th was in hel. long. 66° and in hel. lat. 10° N.; the last spot in hel. long. 42° and hel. lat. 16⅓° N. This gives a total length to the group of more than 24° of solar longitude, or fully one hundred and eighty thousand miles. Its breadth, on the other hand, did not exceed one-fifth of this at its broadest part.

The tendency of long groups is *eventually* to range themselves parallel to the solar equator, but it is not at all uncommon to find streams inclined at a very considerable angle to it in their earlier days. The present group was an illustration of the latter relation, being inclined at an angle of about 15° to the equator, the preceding end of the group being at the lower latitude.

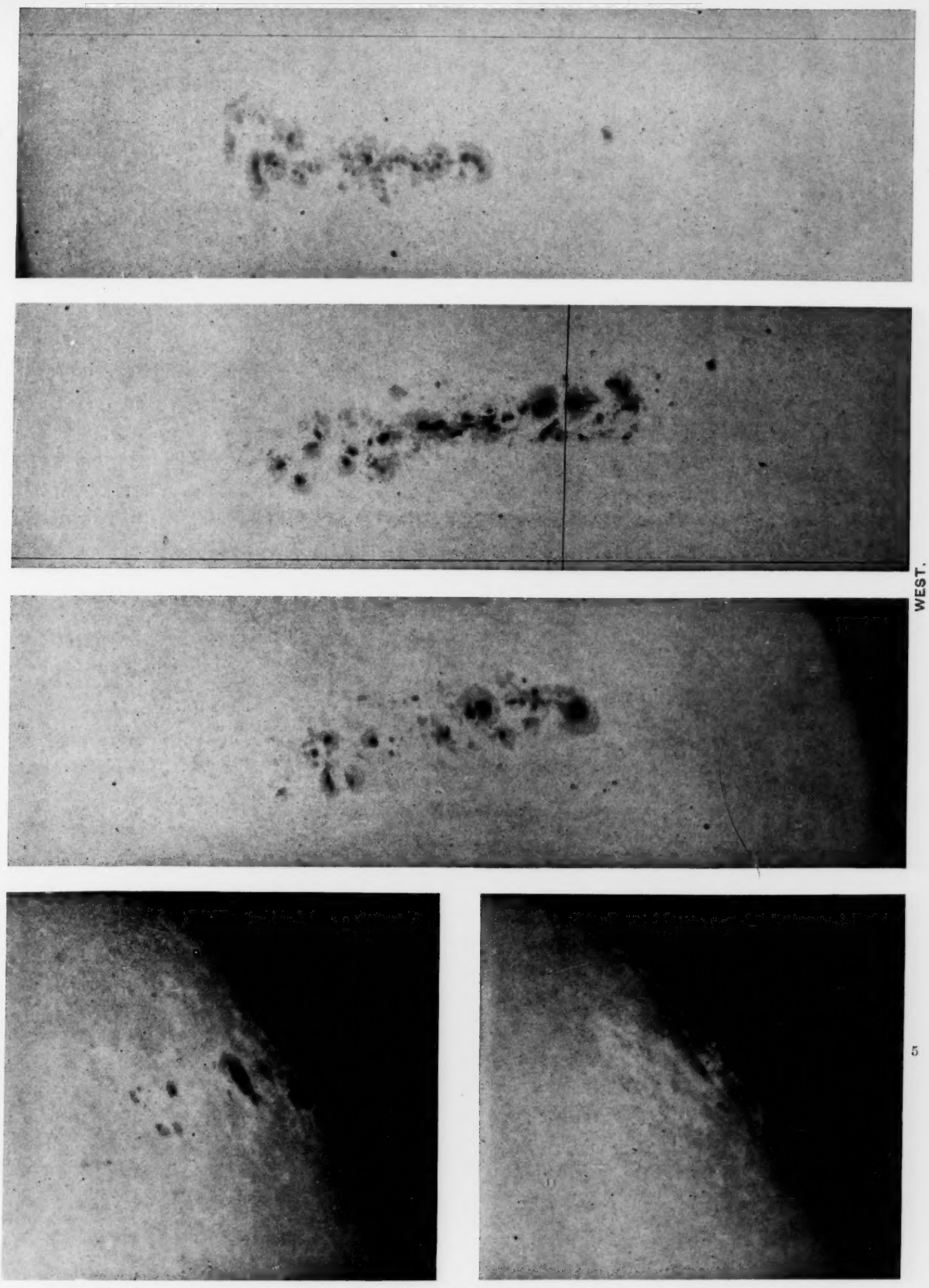
The total area of the group when fully on the central meridian, which it took forty-four hours to cross, amounted to two thousand four hundred millions of square miles.

This stream was not of the type that is usually accompanied by magnetic disturbances. Nevertheless, as the accompanying diagram, which represents the photographic trace of the declination magnet at the Royal Observatory, Greenwich, will show, the quiescence of the magnets was disturbed soon after sundown on September 17th by the sharp, sudden twitch which is so typical of the commencement of a cosmical magnetic storm. If this trace be compared with the photographs given in Knowledge for May, 1892, p. 92, it will be seen that the succeeding oscillations were of a much milder type than those that accompanied the giant spot of February, 1892. Yet they were quite considerable, a wave of 13′, which finished



Copy of the Photographic Trace of the Declination Magnet (Royal Observatory, Greenwich), 1896, Sept. 17d. 17h.—Sept. 19d. 0h., G. Civil Time.

NORTH.



THE GREAT GROUP OF SUNSPOTS OF SEPTEMBER 10th–22nd, 1896, as Photographed at the Royal Observatory, Greenwich.

(Reproduced by permission of the Astronomer Royal.)

		d.	h.	m.	s.	
1.	Taken 1896, September	13	16	13	51	G. Civil Time.
2.	„ 1896, September	16	10	38	15	„ „
3.	„ 1896, September	19	9	31	9	„ „
4.	Taken 1896, September	21	11	49	30	G. Civil Time.
5.	„ 1896, September	22	14	28	50	„ „

XUM

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abruptly at two hours before midnight, following the first significant twitch. Two double waves occurred during the night, followed by a steady increase at sunrise, and a series of small but rapid fluctuations which lasted all day. A strong double wave of 17′ occurred soon after sunset, and the disturbance then gradually died away. In some parts of England considerable auroral displays were noticed during the nights of September 17th and 18th.

It is with great regret that we learn, at the time of going to press, of the sudden death of the distinguished Director of the Paris Observatory, M. François Félix Tisserand, in his fifty-second year. M. Tisserand had only been in command of the observatory four years, succeeding to that post on the death of Admiral Mouchez.

Letters.

[The Editors do not hold themselves responsible for the opinions or statements of correspondents.]

PRISMATIC LUNAR RAINBOWS.

To the Editors of KNOWLEDGE.

SIRS,—On the 21st September, at 7.26 P.M., I noticed a very fine lunar rainbow. It appeared to be similar to a solar rainbow, except that it was fainter. The prismatic colours were distinctly visible. It gradually faded away, and by 7.41 P.M. it had completely disappeared.

I again witnessed a similar phenomenon on the 23rd September, at 7.30 P.M. The bow was, however, less bright than on the preceding occasion, but the red and blue were faintly visible. It had disappeared by 7.33 P.M.

J. M. WADMORE.

To the Editors of KNOWLEDGE.

SIRS,—On September 20th, at twenty minutes to ten, I had the opportunity, in company with another, of witnessing a very beautiful phenomenon.

A dark and massive rain-cloud, which was travelling rapidly towards the east, was seen to have a peculiarly vivid prismatic corona on its western edge. The position of this cloud seemed very much in advance of another thin cloud of pearly whiteness which was seen to surround the moon's disc; the two clouds seemed, nevertheless, continuous.

This bow was twelve moons' breadth in length, and we experienced no difficulty in distinguishing the various colours. The red, green, and blue were seen to best advantage at the middle of the arch, whilst their intermixture with yellow and violet at each end of the bow resembled the colours reflected from moonstones or pearly shells; the violet was innermost, and the sharp boundary line between it and the shiny white was very beautiful.

The whole phenomenon lasted about four minutes, and was totally different from the rather common coronæ and cloud edges seen at this season of the year, and which I have been watching for some time past.

There were no other clouds in the immediate vicinity of the moon—indeed, the whole sky seemed at the time remarkably clear—whilst the dark blue appearance of the west might have had something to do with the unusual appearance which I have endeavoured to describe.

The prismatic edges of clouds are generally regarded as a sign of stormy weather, and judging from what we have experienced lately the phenomenon which we had the privilege of watching amply justifies this conclusion.

Portmadoc. WALTER WILLIAMS, M.B.

PROPER MOTION OF CONSTELLATION URSA MAJOR.

To the Editors of KNOWLEDGE.

SIRS,—At the foot of the article on the constellations of Ursa Major and Ursa Minor which appears in the October Number of KNOWLEDGE, it is stated that all the seven principal stars in the former group have been found to have a common proper motion. Is this correct? In Proctor's "Other Worlds" appears a diagram showing that α and η are travelling in almost the opposite direction *across* the line of sight as compared with the other five. I believe that the spectroscope also confirms this grouping as regards their motion *in* the line of sight. If any recent observations have tended to contradict Proctor's deductions, I should be very glad if you would give the information in an early issue. LAWRENCE B. TAPPENDEN.

[Mr. Tappenden is quite right in taking exception to

ANNUAL PROPER MOTION.

Mr. Reynolds' statement that "all the seven stars have a common proper motion through space." As the accompanying diagram will show, ε and ζ have almost exactly the same proper motion, and γ and δ are similar in direction. But the motion of β differs considerably from that of the four above-named, and α and η are moving, as Proctor quite correctly stated, almost in the opposite direction. It is certain that these two do not belong to the same system as the other five, and I scarcely think the evidence warrants us in following Proctor, and asserting the physical connection of all the five.

The spectroscopic evidence is inconclusive. The Potsdam results for the motion in the line of sight of these stars give practically the same motion of approach for β, γ, ε, ζ, and η, and a smaller motion in the same direction for α. Dr. Huggins found about the same speed for all the five stars, but found that they were receding from us.

The proper motions adopted in the diagram are those derived by Prof. Amvers from his new reduction of Bradley's observations.—E. WALTER MAUNDER.]

MACQUEEN'S BUSTARD (*Otis Macqueeni*).

ON October 17th I was walking along the sea-bank at Easington, Yorkshire, in company with Mr. Eagle Clarke, the well-known ornithologist, and Mr. Bendelack Hewetson, Jun. We all at once noticed a large bird flying low over the fields like an owl, and being pursued by small birds. It skimmed across a high bank and went down in a field beyond. We immediately followed it, and on arriving at the bank crept up to the top and cautiously looked over. There, in the middle of a stubble field, about one hundred and twenty yards from us, was what we took to be a great bustard.

We lay down and watched it with our field glasses. It seemed quite at home, and behaved perfectly naturally. It strutted about with a stately gait somewhat like a peacock, and pecked at the ground here and there in an almost disdainful way. Then it began to dust itself, drawing in its head and ruffling its feathers, and spreading wings and tail. We watched it closely for quite ten minutes, and were fascinated by its interesting ways, probably never observed in England by ornithologists before, for this grand bird was a Macqueen's bustard, and only the third example which has visited our shores.

Meanwhile two men had come on the scene with guns, and after a little manœuvring George Edwin Chubbley shot the bird as his brother Craggs Chubbley put it over to him. Whilst being followed it never seemed flurried.

When flying, the wings of the bird were a striking black and white. The long black tufts on the sides of the neck appeared as black streaks at a distance, and were very conspicuous as the bird stood in the field.

Macqueen's bustard is a desert-loving species inhabiting the steppes of Asia, and why it visits us at all is merely a matter of conjecture, but probably certain young birds wander far from their course and thus manage to reach our coasts.

When the feathers of the bird were turned up we found them to be of a delicate blush pink at the base, contrasting beautifully with the speckled sandy colour of the bird's back. The beak is brownish black, the legs and feet light straw colour, and the eyes very pale straw and very bright.

The length from beak to tail is twenty-eight and a half inches, the tarsus four and a half inches, and the flexure sixteen inches.

The bird was a young male, and its stomach contained vegetable matter and three beetles.

Mr. J. Cordeaux and Mr. H. Bendelack Hewetson, M.R.C.S., arrived on the scene a few minutes after the bird was shot.

Harry F. Witherby.

Notices of Books.

Voxometric Revelation: the Discovery of the Human Voice. By Alfred Augustus North (Examiner in Music to the New Zealand Government for thirteen years). Published by the Authors' and Printers' Joint Publishing Co. Pp. 206. Price 10s. 6d. Of all the problems that vex the soul of the practical musician those connected with voice production and development are the most perplexing. The act of singing is a supremely difficult one to investigate. It is an unknown combination of physical, physiological, and psychical phenomena. It is not hard to get at some of the truth, especially on the physical and physiological side; but beyond this there is, it appears, unlimited scope for speculation and dogmatism. The latest exponent of an absolutely complete and "scientific" explanation of the whole art of singing is Mr. A. Augustus North. If we may believe the author there is really nothing now left for posterity to discover. The hitherto hidden processes of nature are revealed for the benefit of the whole race of mankind. Singing (which must mean fine singing, to be worth mention) is declared to be a spontaneous and natural act "incident to all humanity," and not merely the special gift of the few. "Those who will rightly use their voices" (*i.e.*, of course, on the voxometric method) "and follow out faithfully the general conditions in doing so, hold within themselves the power of commanding health, strength, happiness, and longevity, and will assuredly be laying the foundation of a stronger, a finer, and a more magnificent empire than the world has *ever* seen!" (p. 178).

The "revelation" seems to involve the acceptance of Dr. A. Wilford Hall's theory that sound is not the result of vibration, but is an emanation. Mr. North says: "The human voice, as also every other form of manifestation of a *cause* which we have hitherto been taught to consider a *phenomenon* merely, is not produced in any way according to the general hypotheses on the subject. And vibration is not the cause of sound, but only an effect when sound is made appreciable to mortal conceptions. Sound is, unquestionably, a living, immaterial, substantial force in nature" (p. 65). The italics are the author's.

The features of the "revelation," as regards the theory of voice production, may be summarized as follows:—

1. There is only one register in the whole voice from top to bottom. The laryngoscopists, with their head, throat, chest, upper thin, thick, and lower thick registers, each the product of special behaviour of the vocal cords, are entirely and wofully wrong.

2. Full, pure, round tone results from the reciprocal action of the resonating cavities, not only above the larynx, but indispensably below the larynx, where the compressed air echoes and reinforces the tone rebounding from the hard palate. The pupil is besought continually to "think of the sternum bone as the sound-reflecting element."

3. The larynx must always be kept as *low* in the throat as possible. It *must never be allowed to rise.*

4. The speaking voice of civilized people is declared to be false and unnatural. Voice trainers have erroneously based their singing training upon this false voice.

5. The vowel "ē" (ee) is asserted to be the all-important voice-training vowel. The vowel "ah," which is so generally used by trainers, is "a perfect fiend incarnate."

6. It is asserted that a very large majority of the whole of the civilized race, and especially the inhabitants of the towns and cities all over the world, are not breathing naturally.

In some of Mr. North's teaching we find ourselves in agreement, especially in his pertinacious insistence that resonance should be the chief study of the singer. Whether his theories as to how resonance is caused be right or wrong, there is no question that some of his practice at least would be beneficial. But we are very far from recommending the whole "revelation" as a practicable scheme of voice cultivation. The author, and those who are assisting him to promote the method, show great lack of judgment in their plan of campaign. Thoughtful and earnest enquirers after scientific truth are repelled by prospectuses that might serve for pills or soap. In a matter pre-eminently practical the public cannot be convinced by a mere book, but by the voice trainer who presents to us accomplished results. Until this happens we are compelled to feel, in this, as in many other mundane affairs, that "man never is but always to be blessed."

Results of the Stonyhurst Meteorological and Magnetical Observations for 1895. By Rev. W. Sidgreaves, S.J., F.R.A.S. Statements of the instruments used and the observations made during the year 1895 have come from several observatories, both British and foreign. This year, it will be remembered, was noted for its low winter temperature, and accordingly the Stonyhurst observations show that on two occasions the year gave a minimum thermometer reading when compared with the corresponding months of the previous forty-eight years. One of these occurred on February 18th, when the thermometer registered 8·0°, and the other on October 28th, when the reading was 17·8°. An appendix is contributed by Father Dobson on the results of meteorological observations taken at St. Ignatius College,

Malta; and when compared with the preceding twelve years we again find the lowest temperature registered was 34·2°, on February 19th, 1895.

Argon and Newton: a Realization. By Lieut.-Colonel W. Sedgwick. (W. B. Whittingham & Co.) "The universe is a building put together with materials shaped for building purposes, so as to fit together in certain positions, and in certain positions only; but, at the same time, so hard and solid as to be unbreakable and unalterable under any conditions which obtain now." The purport of this may not be quite clear, but that is our misfortune, as Lieut.-Colonel Sedgwick's intentions are good, and his style is peculiarly original.

The isolation of argon and the identification of terrestrial helium were important, but Lord Rayleigh and Prof. Ramsay little suspected that their discoveries were just what Lieut.-Colonel Sedgwick needed to substantiate the conclusions arrived at in his epoch-making work, "Force as an Entity." Yet Lieut.-Colonel Sedgwick says they were, and who would venture to oppose his view?

We learn that the atom is a sphere with flat places—the form of the monovalent atom being a chipped sphere with one flat place, two for a divalent atom, and so on. Argon and helium probably have spherical atoms; but the inner meaning of this latter characteristic is only clear to Lieut.-Colonel Sedgwick, and we suppress our desire to explain their part in the universe in order to let the words of wisdom appeal directly to our readers. "We build, indeed, nothing upon argon and helium," the gallant author writes, "or with them. In truth, it is their general unsuitability for employment in any kind of building whatever which makes their support of so much importance; though at the same time we recognize that such unsuitability does not go to the length of complete inability to form part of any structure whatever. . . . Though marked unsuitability for building purposes is their characteristic feature, it is, from our point of view, quite possible that they may in some cases be worked into buildings." To prevent possible misconception, we have the temerity to add that Lieut.-Colonel Sedgwick's remarks refer, not to the construction of merely mundane edifices, but to the building of the universe. Before the discovery of argon and helium, all materials were regarded by Lieut.-Colonel Sedgwick as suitable for his purpose; but this was not altogether satisfactory, for his theory called for the existence of materials "unsuited for building operations," and the two new elements met this requirement.

Only one thing more remains to be said. The reader may ask what Newton has to do with the matter? Well, Newton's views on the nature of atoms are practically the same as Lieut.-Colonel Sedgwick's, but he was not able to develop them into a proof of the "first cause"; and it was left to Lieut.-Colonel Sedgwick to accomplish the task which Newton assigned to science. "Force as an Entity," according to Lieut.-Colonel Sedgwick—and who should know better?—is "perhaps unique." "Argon and Newton" is its sequel, and is just as wonderful.

Roads and Pavements in France. By Alfred Perkins Rockwell, A.M., Ph.B. (New York: Wiley & Sons. London: Chapman & Hall.) Illustrated. This account of the mode of construction and maintenance of stone roads in France, where are to be found the most highly educated and able road engineers in the world, should do something towards the improvement of our highways. The methods and practice in one country are not necessarily applicable to another, but there is always something to be learned from the results of experience; therefore contractors and civil engineers will find this contribution to the literature of road making handy and serviceable.

Moorland Idylls. By Grant Allen. (Chatto & Windus.) 6s. Whatever Mr. Grant Allen writes about natural objects and scenes is worth reading. He is a pleasant philosopher, who walks through the beautiful woodlands of Surrey with his eyes wide open, appreciative of everything that lives upon them, and with the breadth of mind required to build up impressions into word pictures which shall be attractive to all nature lovers. This score of essays may seem trifling to the student full of knowledge of idioblasts, epigenesis, and similar profound problems, and critics may take exception to the anthropomorphism which forms the basis of most of the observations; but naturalists who understand the poetry of nature will find their hearts in unison with everything in the book.

The Studio. October. 1s. monthly. To the student treading the maze of modern art, this publication is at once an inspiration and a guide. An outcome of decadent æstheticism, it gives us the best of the new in art. This month, the article on "Japanese Floral Arrangements" is extremely interesting and useful to all desirous of adding new beauties to their surroundings. The observations on the work of C. J. Watson, and the first notice on the "Arts and Crafts," are sincerely written and well illustrated. In fact, all the reproductions are as good as they could possibly be.

BOOKS RECEIVED.

An Archæological Survey of the United Kingdom. By David Murray, LL.D., F.S.A. (Glasgow: James Maclehose & Sons.)

Index to the Genera and Species of the Foraminifera. By Charles Davies Sherborn. Part II. (Smithsonian Institution.)

Elements of Astronomy. By Sir Robert Stawell Ball, LL.D., F.R.S. (Text Books of Science.) (Longmans, Green, & Co.) New edition. 6s. 6d.

Thirteenth Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution. By J. W. Powell, Director. (Washington: Government Printing Office.)

Humphry Davy, Poet and Philosopher. By T. E. Thorpe, LL.D., F.R.S. (Century Science Series.) (Cassell & Co., Ld.)

The Unsolved Riddle. By Victoria Woodhull. (Blades, East, & Blades.)

A Baltic Cruise to the Capitals of Northern Europe. By "Red Cross." (Phipps & Connor, Ld., Tothill Street, S.W.) 1s. Third Edition.

Rocks and Minerals. By J. W. Tutt, F.E.S. (Gill's Practical Series of Object Lesson Books.) (George Gill & Sons.) 1s.

Insects and Spiders. By J. W. Tutt, F.E.S. (In same Series.) 1s.

Model of a Horizontal Steam Engine, with Description of the Parts. (George Philip & Son.) 2s. 6d.

Argon and Newton: a Realization. By Lieut.-Col. W. Sedgwick. (W. B. Whittingham & Co., Ld.) 7s. 6d.

Natural History of Australia. By Frederick G. Aflalo, F.R.G.S., etc. (Macmillan & Co.) 6s.

Elementary Geology. By G. S. Boulger. (William Collins, Sons, & Co., Ld.) 1s. 6d.

Practical Work in Physics.—Part III., Light and Sound. By W. G. Woollcombe, M.A. (Clarendon Press.) 3s.

Evil and Evolution. By the Author of "The Social Horizon." (Macmillan & Co.) 3s. 6d.

Edinburgh Review for October. (Longmans.) 6s.

The Reliquary and Illustrated Archæologist. Vol. II. New Series. (Bemrose & Sons.) 12s.

Everybody's Medical Guide. (Saxon & Co., London.) 6d.

The Wonders of Modern Mechanism. By Charles Henry Cochrane. (J. B. Lippincott Co.) 7s. 6d.

The October Number of *Science Progress* commences a new series, having been converted from a monthly magazine to a quarterly, of a hundred or more pages. The contents of the present number are decidedly technical, but the subjects are varied and soundly dealt with. The most prominent articles in the number are "The Natural History of Igneous Rocks," by Alfred Harker, M.A., and "The Nervous System of Cœlentera," by Prof. Hickson.

XUM

Messrs. Smith, Elder, & Co. have in the press a work by the Rev. H. N. Hutchinson, author of "Extinct Monsters" and other works, entitled "Prehistoric Man and Beast." Sir Henry H. Howorth, M.P., F.R.S, contributes a preface. The book will be illustrated with original drawings by Mr. Cecil Aldin.

BIRD MIGRATION IN GREAT BRITAIN AND IRELAND.

Report of the Committee of the British Association.

BIRD migration, although a subject about which very little is known, has always proved an extremely fascinating one to ornithologists, and, as a consequence, a large amount of literature on the subject has resulted, some of it dealing with acts, but more often it has been of a speculative character.

The British Association determined to give their careful attention to the subject, and accordingly a committee was appointed to investigate the matter. This committee consisted of the following well-known ornithologists:—Prof. Newton, Messrs. John Cordeaux, J. A. Harvie-Brown, R. M. Barrington, W. Eagle Clarke, and Rev. E. P. Knubley.

By a system of schedules all the birds observed at two hundred and three lighthouses and lightships round the coasts of Great Britain and Ireland, from the years 1880-1887, were accurately recorded, as well as the times and dates of their passing. One hundred thousand records, culled from several thousand schedules, were thus obtained. It can easily be imagined what an enormous task it was to reduce this mass of information to an intelligible form, so as to make it of real scientific value. This, however, has now been done by the energy of Mr. W. Eagle Clarke, and the outcome of his years of labour is the report which was read at the Liverpool meeting of the British Association.

I propose here to give a brief summary of this report, and to extract from it the most salient and important facts elicited by the inquiry. "The migration of birds, as observed in the British Islands, is a very complex phenomenon; more so, perhaps, than in any other region of the globe." This may readily be seen. By their geographical position the British Isles form, not only a main and much accustomed highway, but convenient resting quarters for legions of migratory birds, which annually make a double journey between their northern summer and their southern winter quarters. Again, we have a vast bird population of our own, and the majority of these are purely migratory species, while nearly all are migratory to a certain extent. We have a further complication in the fact that our variable climate causes much irregular migration. Having said so much, to show with what an extremely complicated but fascinating problem we are dealing, let us pass on to review it in some detail.

Mr. Clarke has confined himself entirely to facts, which are discussed under the following sections: geographical, seasonal, and meteorological. It may be explained here that the terms "immigration" and "emigration," used below, mean respectively migration to, and migration from, our shores, while the term "migration" is used in a general sense.

Geographical.—*Intermigration between Britain and Northern Continental Europe.*—Between Britain and Northern Continental Europe travel a host of migrants, which are either birds of passage on, or winter visitors to, our shores.

"These immigrants and emigrants from and to Northern Europe, pass and repass between this portion of the Continent and Britain by crossing the North Sea in autumn in a south-westerly direction, and in spring in a north-easterly one, and while the limit to their flight in the north is the Shetland Islands, that on the south extends to the coast of Norfolk."

"After arriving on our eastern shores, these immigrants from the north, some of them after resting for awhile, move either down the east coast, *en route* for more southern winter quarters, or, if winter visitors, to their accustomed haunts in Britain and Ireland."

"The west coasts do not receive *directly* any immigrants from Continental Europe."

Intermigration between the South-East Coast of England and the Coast of Western Europe, or the East and West Route.

"During the autumn, day after day, a stream of migrants, often of great volume, is observed off the coast, flowing chiefly from the south-east to the north-west at the more northerly stations, and from east to west at the southerly ones, across the southernmost waters of the North Sea. . . . . These important immigrations set in during the latter days of September, reach their maximum in October, and continue at intervals until November."

"It is satisfactory to find decided evidence that the birds retrace their flight to the north and east along precisely the same lines as those along which the autumnal southerly and westerly journeys were performed. Thus in the spring these birds depart from the same sections of our eastern seaboard as witnessed their arrival in the autumn. . . . . Whether this east to west stream is a branch of one that passes down the coast of Continental Europe, or whether it has its source in Central Europe, is a matter of conjecture."

This interesting migration route is one of the discoveries of the inquiry. Formerly it was thought by some that in the northern hemisphere there was no migration route trending north in autumn, or south in spring. So convinced was Mr. Charles Dixon of this, that he actually founded a *law of dispersal* on the supposed fact. The present enquiry has now abolished this *fact*, and with it Mr. Dixon's "plausible" theory. Another remarkable fact brought to light is that Heligoland and England draw their migratory hosts from different sources. Herr Gätke, who has done so much valuable and practical work in connection with migration in Heligoland, thought that the birds passing over that island were on their way to England. Mr. Clarke, however, comes to the conclusion, by careful comparison between our observations and Herr Gätke's, that this is not so.

Besides the routes already discussed there are others, but want of space compels me to pass them over without comment. They are:—

"*Intermigration between Britain and Färoes, Iceland, and Greenland; Intermigration between Great Britain and Ireland and the South; East Coast of Great Britain; West Coast of Great Britain; Irish Coasts; South Coast of England; Channel Islands.*"

We now come to the seasonal section of the report.

"In the autumn the birds, when they appear on our shores, have accomplished *the* great business of the year—procreation. Food is still abundant in their favourite resting haunts, and hence there is no particular hurry to move southwards. Thus many species tarry on our coasts or in their vicinity, some for a considerable period. Their numbers are, of course, incomparably greater than during the northward journey, as they are swelled by the numerous young birds, now a few weeks old. All these circumstances and conditions combine to make the autumn movements comparatively easy of observation."

"In spring the all-absorbing duties of the season and the procreative influence are upon the voyagers, and the birds usually hurry on after a short sojourn for rest and food only. Thus the spring movements do not afford much facility or opportunity for observation."

Autumn Immigration.—Birds which have migrated north for the summer, seem to begin to return south towards the end of July, when a few reach our shores. Immigration does not set in in earnest, however, until August, while in September it increases, and in October the flood of migratory birds reaches its highest level, and there are experienced those vast "rushes" upon our shores so often described. . . . . "The immigratory movements occurring in November are not only on a very much reduced scale, *but after the middle of the month the immigration of such birds as spend the summer in the north entirely ceases*, with the exception of those of certain marine species (duck, gulls, grebes, swans), whose late movements to the south are dependent upon severe weather conditions. This is entirely contrary to the views hitherto propounded regarding the limits of these movements, but it is, nevertheless, a fact well established by this inquiry."

Except that they do not begin until the end of September, the immigration from the west by the east and west route nearly coincides with that from the north.

"During immigration our shores are reached during the late night or early morning on the part of migrants from the north. On the contrary, the immigratory movements from the east, across the narrows of the North Sea, appear to be performed during the daytime."

Autumn Emigration.—A few of our summer visitors leave us in July (*e.g.*, swifts and adult cuckoos). In August emigration increases, while "September witnesses the height and close of the emigration of the bulk of the smaller British summer visitors. The movements of forty-two of these emigrants appear in the records for the month; while those of the partial migrants are also considerable, over forty species being recorded. . . . . The October emigrants among the summer birds are not numerous. The partial migrants, on the other hand, are much on the move." These movements of partial migrants are often pronounced, and "rushes" are recorded during October, but they cease by or during the first half of November. A partial migrant is a bird which, although it may be sedentary in our islands as a species, yet many individuals of the species are strictly migratory. Thus many birds, such as the thrush, blackbird, robin, leave us in the autumn, and their places are taken by Continental individuals, and so we do not miss them.

Winter movements are of a very different nature, and are entirely due to a fall in temperature, as is proved by the fact that "in mild winters the only movements recorded are a few local migrations, which strictly coincide with the occasional periods of cold from which hardly any season is entirely exempt."

Spring Immigration.—The first bird-harbingers of spring are recorded for February, and a considerable number return in March. During both these months, however, but few summer visitors appear, the immigrants being chiefly partial migrants, "which had fled the country through the winter cold." "April is a month of pronounced immigration on the part of summer visitors. In connection with the arrival of these earliest immigrants among our summer visitors during March or April, a remarkable and interesting fact remains to be mentioned—namely, that the great majority of these birds are recorded first for the south-western area of the British region—the south-west coast of England and Ireland. It thus seems probable that the first arrival of the spring migrants not unnaturally occurs on those parts of our isles which are the warmest so early in the season." During May the stream flows on, while "during the first half of June several species whose breeding range extends to the Polar regions, appear in considerable numbers on our shores on their way to the far north; a few appear even still later. In connection with the spring immigration, it has to be remarked that the observations are all in favour of the theory that the earliest arrivals among the summer visitors to our islands are British-breeding birds," and that the "migrants bound for the north are the last of their kind to appear in the British area."

Spring Emigration.—Birds that have wintered with us, or further south, begin to leave our shores in February. "The chief emigratory movements of this month are the departure of larks and rooks along the east and west route to the Continent. During March these south-easterly movements become more pronounced, and emigration for the north also commences. During April and May, emigration is in full swing, and even in June a few birds leave us for their northern breeding stations.

METEOROLOGICAL.—Special attention has been bestowed upon this section of the report, since the actual relationships between migrational and meteorological phenomena have not hitherto received the attention they deserve. The daily weather reports for Western Europe have been closely studied in connection with migration. Ordinary weather has no influence on migration. Extraordinary weather may influence bird migration in two ways. It "may act either (1) as barriers to the ordinary movements, or (2) in diametrically the opposite direction as incentives to great movements or 'rushes,' as they have been termed."

During a cyclonic spell, a weather barrier "dams back, as it were," the ordinary seasonal migratory stream. The formation of an anti-cyclone removes the cyclonic weather barrier, and so releases the flood of migration. "The movements just described take place when gentle pressure-gradients bridge, as it were, the North Sea with fine weather between Scandinavia and Britain. Such an extension, however, of the favourable conditions does not always prevail for the entire journey—that is to say, they do not always reach to the British side of the North Sea. Indeed, it not unfrequently happens that the birds reach our shores under more or less unfavourable weather conditions. When such is the case the immigrants arrive in Britain in a correspondingly exhausted condition, and, no doubt, many sometimes perish during the journey."

There are other meteorological conditions to be considered in connection with the subject. Outbursts of ungenial weather in summer or winter often produce migration, but this form of migration is only of a partial kind. It is in early autumn and early spring that migration is hastened or held back by extraordinary weather.

"*Winds.*—The importance attached to winds in connection with bird migration has hitherto been much overestimated by popular writers, and their influence, such as it is, misunderstood. "The conclusions to be drawn from a careful study of the subject are: (1) that the *direction* of the wind has no influence whatever *as an incentive to migration;* but that (2) its *force* is certainly an important factor, inasmuch as it may make migration an impossibility, arrest to a greater or lesser degree its progress, or even blow birds out of their course. . . . . It is, however, a fact that particular winds almost invariably prevail during the great autumnal movements, and these have hitherto been considered by some as the direct incentives to such migrations. Such is not the case, and it may be at once stated that these supposed favourable breezes are simply another direct result of the pressure distribution favourable to the movements."

In conclusion, I may say that Mr. Eagle Clarke's report is merely a summary of the results obtained with regard to migration as a whole. For this the author deserves the

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heartiest thanks from every ornithologist in the land. There yet remains a vast amount of information to be culled from the schedules so carefully and keenly kept by the lighthouse and lightship keepers. We hope, and indeed believe, that Mr. Clarke is going to continue his labours; and in the near future, when he has worked out the migration phases of individual species, we may look for a monumental and trustworthy account of the fascinating subject of the migration of birds in the British Islands.

HARRY F. WITHERBY.

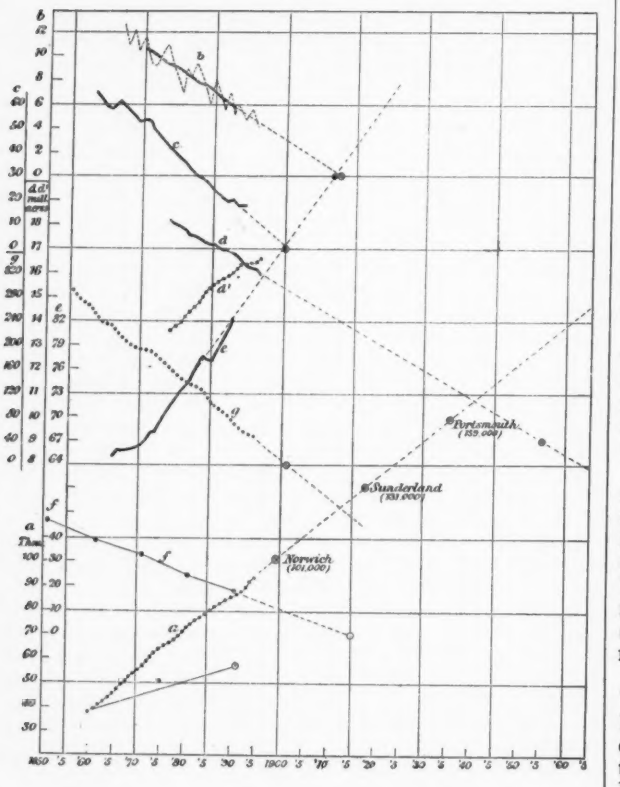
[Copies of the Report on Bird Migration can be obtained at the British Association, Burlington House, London, price 6d.]

FORECASTING BY CURVES.

By ALEX. B. MACDOWALL, M.A.

THERE are some curves of social data which, extending through a series of years, are approximately straight lines. There are others not so regular, but the general course of which, after some smoothing or averaging process has been applied, is shown to be approximately a straight line. One is tempted to extend such curves in the same direction, by way of seeing what may happen in the future.

I propose to apply this rough-and-ready method of forecasting to such unlike things as the following:—Lunacy, the army death rate, coal mine explosions, acreage under crops, illiteracy, and suicide.



The degree of confidence (or diffidence) with which one makes these conjectures is, of course, different in different cases. Thus it is, perhaps, easier to forecast the future of illiteracy than that of agriculture. Even if a forecast be rejected as worthless, it may still be instructive to study the unextended curve.

In our very promiscuous diagram it is to be understood that each curve stands by itself, having its own vertical scale, indicated by a letter (*a*, *b*, *c*, etc.). A smoothing process has been applied in the case of *b*, *c*, and *e*.

A few words on each of the curves. Commencing with lunacy (*a*), we have a curve showing the number of insane persons under restraint in England and Wales in each year from 1860 to 1894. This has risen with steady rapidity from about thirty-eight thousand to ninety-four thousand, a rate of growth much more rapid than that of population; a lower line, drawn from 1861 to 1891, shows what the growth would have been at the population rate.

Does this mean that insanity is increasing among us? Not necessarily; and certainly the curve does not measure such growth (if there be growth). It is well known that more lunatics are now put under restraint than formerly, and a process of accumulation has been going on in asylums, owing to removals, by death or discharge, being generally less in number than the admissions. On the other hand, the growing tension of modern life, and the growth of nervous diseases, seem to render an increase of insanity very probable, and some figures relating to lunacy might be cited which favour the belief in its increase.

Extending this curve with a dotted line, we come, by about the end of the century, to a figure equal to the population of Norwich (one hundred and one thousand); twenty years later to a Sunderland of lunatics; and about 1936 to a Portsmouth!

Whatever the future growth, it is in any case an ugly fact that we have nearly one hundred thousand "officially known lunatics, idiots, and persons of unsound mind" among us, *i.e.*, about one in three hundred (and how many free?).

As to the causes of insanity, hereditary influence bulks most largely. To intemperance is attributed 20·9 per cent. in males, and 8·1 per cent. in females.

In curve *b*, the dotted one, we have the fluctuation in the death rate of the army in the United Kingdom since 1866. This has been brought down to 4·2 per thousand in 1895 (from 12·6 at the outset). The continuous curve is the result of smoothing with averages of ten, *i.e.*, each year's point represents an average of ten years.

Now it would be a mistake to attribute this rapid decline wholly to sanitary and medical improvement. Part of it is no doubt due to the fact that the army has been growing younger on the short-service system. Thus, the number of men over thirty has declined steadily in the last twenty years.

If we extend the smooth curve we find it to reach the zero line about 1911. It seems impossible to suppose the army death rate quite extinguished, though it may very likely continue to decline for a time. A death rate of only one would mean over one hundred deaths in this country. The curve may be usefully compared with general death-rate curves as showing what has been accomplished with a segregated class of men of a given age-group under strict regulations.

Our next curve, *c*, relates to coal mine explosions in the United Kingdom. The annual numbers of these since 1858 have been smoothed with averages of five. These explosions numbered seventy in 1858, but only twenty-two in 1894, and the figure has been as low as twelve. Extending the curve, it would appear that by the beginning of next century, if the same rate of progress is maintained, this destructive form of accident should at least be reduced to a very small figure, if not wholly prevented.

The shrinkage of land under the plough in Great Britain

is a remarkable feature of our time. In d we have a curve showing how the arable land has diminished since 1876. This curve goes down steadily from about eighteen to sixteen million acres. The reduction of wheat-growing alone accounts for most of the loss. Let us extend the curve. By the middle of next century we get to about one-half of the initial acreage. But, of course, "much may happen before then." In curve d^1 is represented the growth of "permanent pasture." Some care is required in its interpretation; but we need not here stop to explain.

We have made rapid strides of late in national education, and the number of those persons who take up the responsibilities of matrimony without being able to write their own names is now small and dwindling. Here we have a pretty straight curve (g), showing the annual numbers of men in one thousand marriages in England who signed the register by mark (from 1855 to 1894); from two hundred and eighty-eight it descends to forty-six. Extending, we come to zero about the beginning of next century. From this and other signs we seem to be getting within sight of universal education (or what may be called so): that millennium in which (by prospectus) we were all to have become virtuous and happy!

Ireland is, of course, behind us in the matter of education. The curve f indicates the percentage of persons five years old and upwards who could neither read nor write in the census years 1851, 1861, etc. Its general course conducts us to zero about 1915, when, it may be hoped, illiteracy should be approximately extinct.

These signs of progress are, no doubt, gratifying, so far. But there is "another side to the shield." Let us look at the death rate of suicide in England. The figures are here (e) smoothed with averages of ten. Note the rapid rise. In 1860 the rate was sixty per million persons living; in 1894 it was ninety-one!

Following the general course of the smoothed curve as extended, we come to a rate of one hundred about 1910. Is it not a startling comment on our civilization that so many persons (about fifty-two a week in England, and nine a week in London at present) elect to have done with it by putting out the light of their earthly life!

SOME CURIOUS FACTS IN PLANT DISTRIBUTION.—V.

By W. BOTTING HEMSLEY, F.R.S.

I WILL conclude my remarks on insular floras with a brief account of the flora of the British Islands, which will, perhaps, be more easily followed by the majority of readers, because popular names can be introduced more freely. Persons who have visited adjacent parts of the Continent will have noticed nothing strikingly different in the vegetation in localities where it is least affected by cultivation; that is to say, where it has been least disturbed by man. The aspect of the vegetation may be very different in some districts, consequent on the extensive planting of certain kinds of trees—the Lombardy poplar in the North of France, for example; but the wild flowers and the weeds of cultivation are much the same, according to soil, situation, and elevation. This indicates a recent connection, geologically, with the Continent, and convincing evidence is not wanting to establish the fact.

The British flora is only a fragment of a flora whose elements have a very wide range; wider, indeed, than any other. A large proportion of the species extend across Northern Asia to the Pacific, and many are spread all round the northern hemisphere. This applies more especially to those inhabiting the colder parts of the kingdom, but by no means exclusively, as I shall presently show. A few recur in the mountains of tropical Asia, Africa, and America, and some, as I have already pointed out, reach the southern limits of vegetation. Coming to the genera, a very large number of them are of worldwide distribution. For example, the buttercup genus (*Ranunculus*), the willow-herb genus (*Epilobium*), the speedwell genus (*Veronica*), and the sundew genus (*Drosera*), belong to this category; and each is represented in New Zealand by a much larger number of species than it is in our own country. But before giving further examples of distribution I will give a few comparative statistics bearing on the composition and extent of the British flora. Excluding the so-called critical species—that is to say, species founded on very slight differential characters—of such genera as *Rubus* (brambles), *Rosa*, and *Hieracium* (hawkweeds), the number of species of flowering plants and ferns native of the British Islands is less than fifteen hundred, belonging to about five hundred and forty genera and ninety-seven natural orders. The number of natural orders, or families, as they are sometimes termed, in the whole world is about two hundred and ten, so that nearly half of them are represented in this very small area. The total number of genera and species in the whole world is not so easily calculated; but approximately the former amount to between eight thousand and ten thousand, and the latter to between one hundred thousand and one hundred and twenty thousand.* The differences between the highest and lowest of each of these respective totals in a way represents the diversity of opinion among botanists as to the degree to which subdivision should be carried. Further, I may explain, this diversity of opinion is due to the fact that vegetable organisms, as well as animal, are not mathematically definable quantities, but a series or chain of beings, ranging from microscopic one-celled individuals to the most complex and highly organized members of the whole system. Some of the orders, genera, and species of this system are so distinct from their nearest allies as to be easily defined, suggesting the extinction of connecting links; whilst in other parts of the system the gradations are so slight and the relationships so complex that their classification is necessarily, to a greater or less extent, artificial and arbitrary.

I have already alluded to the cosmopolitan character of the genera of British plants and the wide range of many of the species, and I will now give some further illustrations of these facts. In the first place there is not a single genus peculiar to the islands, nor even one well-defined species; I mean an easily recognized species such as the daisy or dandelion, and like them easily distinguished from their nearest allies in the native flora. A score or two of critical species have been founded on British specimens, and they have not been actually identified with Continental forms; but it does not follow that they do not exist on the Continent.

Before going further I ought to explain that my remarks refer to the natural distribution of plants as distinguished from colonization consequent on their introduction through human agency. A person going from England to the United States or Canada would see numbers of our cornfield and roadside weeds, apparently as much at home there as here; but there is good evidence that they were introduced accidentally or intentionally by man, though

* It should be borne in mind that these numbers do not include the exceedingly numerous mosses, seaweeds, funguses, and other low organisms.

they are now spread all across that vast continent, from Atlantic to Pacific. At the Cape of Good Hope, in New Zealand and Australia, the same plants have established themselves. But besides these comparatively modern emigrants, the Canadian flora, for example, includes among its aboriginal plants such familiar ones as the wood-anemone, water-crowfoot, ladies'-smock, scurvy-grass, wood-sorrel, purple avens, strawberry, agrimony, sundew, willow-herb, valerian, harebell, whortleberry, crowberry, cranberry, sea-lavender, thrift, and scores of others, to say nothing of closely allied species of other genera. Some of these plants may be commoner there; others here. Of course the aspect of the vegetation of a locality depends upon the predominating species, and varies, according to physical conditions, in places contiguous to each other; the change often being very abrupt.

In a former paper I mentioned the recurrence of the crowberry (*Empetrum*) in the southern hemisphere. As already stated, many northern plants reach the southern hemisphere, but they usually inhabit suitable intermediate localities, including the mountains of the tropics. Isolated localities of other northern plants in the south are occupied by the bird's-eye primrose (*Primula farinosa*)—or a species so near it as to render the fact equally remarkable—at Cape Horn and the Falkland Islands; and by the lady's-mantle (*Alchemilla vulgaris*) in the Australian Alps. A parallel is offered by the existence of the long-leaved sundew (*Drosera longifolia*) on the mountains of the remote Sandwich Islands.

The first botanical explorers of the peaks of Fernando Po, St. Thomas Island, and the Cameroons in western tropical Africa, discovered quite a large colony of European (chiefly British) plants, associated with types more peculiarly African. Thirty-eight out of the fifty-six genera collected are common to Britain, and upwards of twenty species. Among the latter are the sanicle (*Sanicula europæa*), the navelwort (*Cotyledon Umbilicus*), the devil's-bit scabious (*Scabiosa succisa*), the common goose-grass or cleavers (*Galium aparine*), and such comparatively rare little plants as *Sibthorpia europæa* and *Limosella aquatica*.

Now a few particulars concerning some of the trees of the British Islands. We have one species of oak (of which there are several more or less distinct varieties), one species of beech, one of ash, one each of alder, elm, hornbeam, holly, yew, fir, and so on. Of willows there are two large arboreous kinds, besides several that are large shrubs or small trees. The distribution of the British species of these trees, as well as the distribution and development of the genera to which they belong, outside of Britain, is exceedingly interesting. The British oak (*Quercus Robur*), for instance, is spread nearly all over Europe, almost from the Arctic Circle to the Mediterranean, and it extends to Asia Minor; so that we have no right to regard it as specially British. In this wide area it varies considerably, and one of the most striking varieties is found in the Pyrenees. It so closely resembles the Lombardy poplar as to be easily mistaken for it at a short distance. There are trees of it in Kew Gardens.

But our oak is only one out of at least three hundred species of *Quercus* spread over Europe, Asia, and North America, extending southward in America almost to the Equator, and in Eastern Asia through the Malay Archipelago to New Guinea, the only part in which the genus reaches the southern hemisphere.* In Africa oaks occur only in the countries bordering the Mediterranean. The variety of foliage and fruit exhibited by this long array of species is surprising, and they are not less beautiful than varied. Imagine an oak with glossy, shining leaves eighteen inches in length, and elegant acorns three to four inches across!

The distribution of beech trees (*Fagus*) is very different, the greatest concentration of species being in the southern hemisphere, where, in the extreme south of America, in New Zealand, in Tasmania, and in the mountains of South-Eastern Australia, they form large forests. In New Zealand, where there is the greatest development, they are universally called birch trees.

Willows (*Salix*) are specially numerous in north temperate and cold regions, and about twenty small shrubby species are found within the Arctic Circle, forming a good part of the woody vegetation. But willows are not restricted to the regions named; they are also found in hot and dry regions, and, curiously enough, they inhabit just those countries in which there are no oaks. In America there is one species which ranges from North Mexico, through Central America and the West Indies, to Chili and Argentina. In Africa there are several species, one being common on the banks of the Gariep or Orange River and elsewhere in South Africa. In Asia, willows are not found south of the Malay Peninsula, where, however, one species descends the rivers to the tidal forests of tropical Pegu and Tenasserim. The genus is altogether unrepresented in the Malay Archipelago, Polynesia, and New Zealand.

Our holly (*Ilex*), again, is one species out of about one hundred and fifty belonging to the genus. It has a wide range in Europe, from Southern Scandinavia to the Mediterranean, and eastward to the Caucasus. The genus is widely spread in warm and temperate countries, though rare in Africa and Australia, and not reaching New Zealand. In China and Japan hollies are numerous, there being about fifteen species in the latter country.

The mention of Japan suggests a few comparisons between the floras of the British and Japanese Islands. Similarly situated with regard to the nearest continent, though in a considerably lower latitude, Japan enjoys about the same average winter temperature as England, with a higher summer temperature. The approximate number of species of flowering plants and ferns inhabiting Japan is three thousand, or double that of the British Islands. I have mentioned that there is a zone of vegetation stretching from the Atlantic across Europe and Asia to the Pacific, in which a large percentage of the plants are specifically the same. China Proper and Japan lie just without this zone, though it is true that a considerable number of species are common to those countries and Britain; but they are lost among the very numerous species peculiar to the region. Upwards of forty per cent. of the species are peculiar to Japan, besides a number of genera. Instead of one species of each of the various kinds of forest trees, it has twenty-two species of oak, as many of maple, fifteen hollies, fifteen pines and firs, six birches, four hornbeams, four alders, and three elms, to say nothing of a host of others belonging to natural orders not represented in the British Islands. There is also an abundance of shrubs and trees, both evergreen and deciduous, which bear showy flowers; and the herbaceous plants, taken as a whole, are more brilliantly coloured than our own. Fortunately our climate, with all its faults, is favourable to the development of many of the ornamental plants of the Far East. I need only mention such genera as *Pæonia*, *Aster*, *Chrysanthemum*, *Clematis*, *Berberis*, *Aucuba*, *Wistaria*, *Camellia*, *Magnolia*, and the numerous evergreen members of the cypress and fir family.

* In the Kew Herbarium there is a leafless branch, bearing male flowers, which are exactly those of an oak. The specimen is from the Pilcomayo River, between Paraguay and Argentina.

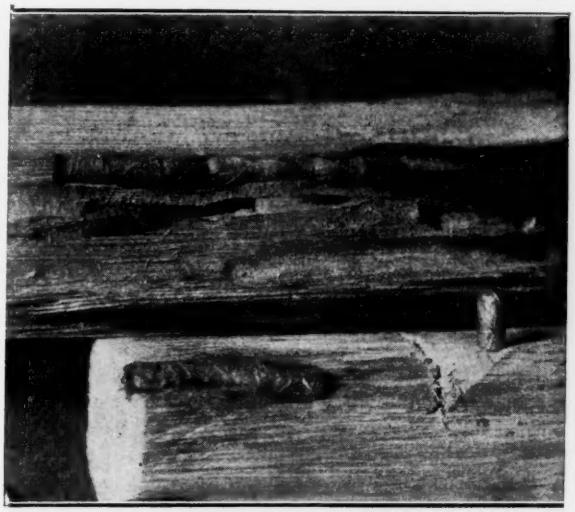
THE LEAF-CUTTING BEE.

By Francis M. Duncan.

THE leaf-cutting bee (*Megachile centuncularis*) is by no means a remarkable looking insect, and from its humble exterior no one would imagine it to be gifted with a high sense of intelligence; it does, however, display a surprising amount of ingenuity in the construction of the cells in which it places its eggs.

These bees are black in colour, with reddish hairs on the thorax, and white down upon the head. They are somewhat smaller than the hive bee, and are to be seen in most gardens during the summer months busily engaged cutting rose-leaves with their strong four-toothed mandibles.

The bee burrows a hole in the ground or in decaying wood, forming a tunnel in which to place the cells; it then flies away to the neighbouring rose-bushes, and, selecting a leaf, cuts a portion from it, which it carefully rolls up and flies off with to the burrow. This manœuvre is



repeated several times, until ten or twelve pieces have been cut; the bee then enters the tunnel, and begins to twist and fold the leaves, making them fit together into a sort of funnel-shaped cone, something like a thimble. So perfectly are these cells constructed, that they may be removed from the burrow without falling to pieces, although the leaves of which they are made are neither sewn or gummed together.

As soon as the cell is finished, the bee proceeds to make a cake of honey and pollen, on which the future inhabitant will live. It then lays an egg beside the cake, and flies off to find another leaf wherewith to close the entrance of the cell.

A circular piece is cut from a leaf, and the bee flies home with it, and so nicely has this little circle been cut that it exactly fits the opening, into which the bee pushes it, closing the cell completely. So that there may be no fear of any honey leaking out, the bee flies off again and cuts two more circular pieces from the rose-bush, which it fixes securely over the first one. When this cell is finished a second is constructed which joins the first, so eight or ten cells are usually to be found together in one burrow. When all is finished the leaf-cutter closes the perpendicular shaft leading to the burrow and flies away.

The larva, when full grown, spins a silken cocoon within and united to the sides of the cell.

The illustration shows the nest of a leaf-cutting bee found in the decayed wood of an old gatepost; one of the cells has been placed in an upright position to show its compact and thimble-like form.

WAVES.—XI.

THE SEA OF ETHER.

By Vaughan Cornish, M.Sc.

FAR away in the ether the sun is a storm centre, ever creating waves which beat upon the earth as the waves of ocean beat upon our coasts. The much-sounding sea is silent save where the billows break; so, too, the ocean of ether is cold and dark, but its waves give light and heat when they beat upon the earth.

A mirror shining in the sun gives back his light and gets but little warmth. The dark, rough surface of the soil, which gives back little light, grows warm in the sun's rays. The mirror, like the vertical face of a stone pier built out into deep water, prevents the waves from breaking and reflects them back upon their path. A dark surface acts like the dead resistance of the beach, absorbing nearly all the energy of the waves and giving but little back. The energy which was in the wave, changed in form, becomes the warmth of the dark body. In the ether the wave travels smoothly on, each part of the elastic medium taking up the motion as the pulse arrives, and in one complete swing passing on all the energy to the next part, returning itself to rest—ready, however, to take up the motion of the next oncoming pulse. The wave-length of light is simply the distance between two pulses; there is no physical connection due to lagging of energy behind the wave as in the wind waves of the sea, and if the sun be screened or a flame be extinguished the ether does not glow.

If the pulses of ether follow one another somewhat slowly, they excite our eyes so as to produce the sensation of redness. If the pulses succeed each other more and more quickly, the sensations are those of yellow, green, blue, and violet. If the pulses follow one another at still shorter intervals, the light passes slowly into darkness. So, also, sound pulses succeeding one another too quickly are not heard. Our organs of sense, "beautifully delicate," as we like to call them, are too coarse to detect the minuter ripplings of air or ether; neither does the scope of our vision enable us to detect those pulses of ether which follow each other at comparatively great distance, any more than the eye can distinguish the long, flat billow which we call the flood tide. The widely separated pulses of ether are, however, detected by their warming power. The pulses of ether which succeed one another more rapidly have generally little warming power, their energy being comparatively small. The effects they produce resemble those of rapid tremors or jarring. They shake things to pieces—not big things which swing slowly, but such things as molecules, which vibrate in about the same time as the interval between two pulses.

It seems that every body of which we know anything—at any temperature which we have ever reached—is always disturbing the atmosphere of ether in which all things are immersed:* for every body is warmed by the mere neighbourhood of a warmer body. This occurs even when the warmer body is nearly at the lowest temperature of

* The *evidence* of an ether is dealt with in Chapter XIII. of my "Short Studies in Physical Science."

XUM

artificial cold. No heat, however, travels; what travels is a wave which, beating upon the colder body, warms it. It is not to be thought that the mere neighbourhood of a colder body causes waves to start from the hotter; one must suppose rather that the action is always going on, but that the warming effects only become sensible when one body is colder than the other. The effect, too, is reciprocal, for the hotter body is cooled when a colder is in its neighbourhood. It is almost obvious that a body cannot go on making waves which carry energy through the ether without itself losing energy. In the neighbourhood of a similar but colder body the hotter loses more energy than it receives from the colder until their temperatures become equal, when the waves which they mutually emit and absorb are of equal heating value and there is no further change of temperature. Thus, as long as a body has any heat at all, as long as the molecular parts are dancing (whether rhythmically or with jostling), the body sends out ether waves. When the temperature of the body is being raised, vibrations of greater rapidity are set up, while the slower movements do not die, but, on the contrary, increase in amplitude as more energy is put into the body. The slower movements begin first, and at any given time theirs is the greater part of the energy which the body possesses in virtue of its temperature. This is why the production of an intensely bright light always involves the expenditure of so much energy. The brightest rays, which have little energy, will only come after the others have been produced, and they are also the first to die out.

As the slow succeeding pulses of ether emitted by a hot body have more energy than the others, and as all the pulses traverse ether at the same rate, one must conclude that the amplitude of the vibrations of the ether is greater in the case of the slower pulses, much as in a storm those waves whose crests are most widely separated are also higher from trough to crest than the shorter waves which have been formed later. The vibration in ether is different, and is kept up in a different way from the swing of the water in the waves of the sea. The free undulation in water is maintained by mutual attraction between the water and the earth, and by the inertia of the water, which causes it in each half-swing to pass the position of equilibrium. There are, however, other kinds of waves in fluids which seem more nearly to resemble the ether waves in the mechanism of vibration, namely, the elastic waves, such as sound waves, which, when once set up, run freely by the mutual action of the parts of the fluid. The particles jump forward a little way, forcing themselves in between the particles in front. They produce thus a compressed layer, which in its turn compresses the next layer by a similar action, itself quickly recovering from the pressure by the spring-back of the particles. The loudness of a sound depends upon the amount of compression, or upon the difference of pressure between the condensed and the rarefied part. Amplitude in the case of sound means, therefore, the amount of a compression, not the length of the excursion of a vibrating particle. There is, again, another kind of elastic wave—for there is an elasticity of shape as well as an elasticity of volume. Fluids offer an elastic resistance to change of volume, and can therefore transmit a wave of compression or of rarefaction; but change of shape calls out no elastic resistance in fluids. It is otherwise with solids, which spring back if de-formed and vibrate elastically, the shape of the solid going through a repeating series of changes of form, the vibrations diminishing quickly or slowly according as the solid is more or less viscous. This kind of vibration is transmitted by solids in the manner of a wave, as the following example shows. Let a long wire or cord be hung vertically, the upper end being forcibly clamped so that it cannot move, and a weight being attached to the lower end so as to keep the wire taut. If the weight—that is to say, the lower end of the wire—be twisted, each part of the wire follows the twist. If the substance be very rigid (as iron, for instance) the longitudinal transmission of the effect of the twist is very rapid. With a less rigid body—say, an india-rubber cord—the parts lag more behind. If, now, the end of the wire or cord be let go the end untwists, twists up again in the reverse direction, untwists again, and so on for a longer or shorter time according as the body is less or more viscous. In twisting or in untwisting each part of the wire is a certain definite time behind the lower end, for the effect is transmitted from point to point at a definite speed which is constant for each substance, and is the rate of transmission of a wave of transverse displacement in that substance. The rate is greater in more rigid bodies, for rigidity is the transmitting force, but is diminished by greater density, for the mass to be moved is proportional to the density.

Dismissing as inapplicable the case of waves, such as those of the sea, which run by attraction to an external body, we have to enquire whether ether waves, such as produce the sensation of light, are elastic waves of longitudinal displacement (like sound waves) or of transverse displacement, or whether they are of both kinds? The fundamental experiment which shows that light is produced by waves is that of interference. If the light from a point reach a screen by two paths of slightly different length, a series of light and dark bands is produced upon the screen where the rays overlap. This shows that two portions of light may either give a double illumination or no illumination, according to the difference of the distances traversed by the two rays from their common starting point. Where the vibrations of the ether are in the same phase of motion the amount of motion is doubled, giving increased illumination; where the vibrations are in opposite phases there is no illumination. Longitudinal waves are always capable of interference, but two parallel or coincident waves of transverse displacement, of which the vibrations are in (fixed) directions at right angles to one another, could not interfere so as to give diminished motion (*i.e.*, dark bands), for no part of the motion of vibration in one ray is at all in the direction of the vibrations of the other. This case of non-interference has been shown to occur in ether waves when subjected to the treatment called "polarization." It is therefore concluded that the waves of ether, which give heating, lighting, and chemical effects, are waves of transverse displacement, whence follows the corollary that ether resembles a solid in possessing rigidity. The enormous velocity of light waves, which is thousands of times greater than the rate at which ordinary solids transmit wave motion, shows that the rigidity of ether is extremely great in proportion to its density.

The intensity of light in a vacuum diminishes with the square of the distance from a luminous point which is radiating in all directions. Now the wave front in such a case is a spherical shell whose centre is the luminous point. The area of surface of the shell increases as the square of the radius, hence it follows that the total illuminating effect over the whole surface of the shell is always the same whatever be its radius; or, in other words, light travels through ether without loss. This shows, within the limits of experimental error, that ether is perfectly free from viscosity, the wave motion undergoing no diminution through any sort of frictional resistance. The energy

which sets out from the sun on its journey to the earth is passed on to us intact, no part, apparently, being held back from us by the ether.

The ether is all-pervading as well as all-encompassing, for ethereal wave motions are passed on through solids and liquids at a velocity far exceeding that proper to the elasticity of the substances themselves. This is readily shown in the case of bodies transparent to light, and can also be shown by special devices in the case of bodies transparent to the longer waves, which are detected by their heating effect. Other bodies which cannot be penetrated by these means are transparent to the very long waves produced by electric surgings. That the medium which transmits electric waves is the same as that which transmits illuminating rays is inferred from the fact that the velocity of electric waves is the same as the velocity of light. Moreover, electric waves can be polarized, showing that they are waves of transverse displacement.

No evidence has been obtained of the transmission of longitudinal waves in ether, from which it seems that ether is incompressible, or nearly so. Were it otherwise one would expect to get compression waves of ether when light is reflected.

The use of lenses is to modify the wave front of lighting waves. Their transmission is slower in glass than in air, the ether in a solid being weighted or clogged, or else having its stiffness relaxed. Light which passes through the thick part of a lens is retarded more than that which passes through the thin part, and the wave which emerges from a convex lens has therefore a concave front. The area of the wave front consequently contracts to a point at a certain distance from the lens, and here the amplitude of the wave, and consequently the illuminating effect, is enormously increased.

The mode of vibration of the ether in the plane at right angles to the direction of propagation of the wave cannot properly be said to be *known*, for we are ignorant of the ultimate constitution of ether. There is no doubt, however, that the motions are *successfully represented* by the ordinary wave theory of light, which assumes a mechanical displacement such as occurs in the vibrations of the rigid sorts of molecular matter. According to the wave theory of light, the ether receives from a glowing solid, motions which vary from instant to instant. There is no regularity in the succession of these motions, owing to the confused jostling of the particles of the heated solid. Consequently, if we consider the vibrations in a fixed plane cutting the ray of light at right angles, the excursions of the ether particles in successive instants undergo such permutations as the following. At the first instant the particle is moving clockwise in a circular orbit. This changes to an ellipse of constantly increasing eccentricity, which presently closes up till it becomes a straight line. At this moment the particle has the rectilinear harmonic motion which best satisfies the ordinary conception of a "vibration." Presently, however, the line opens out into an ellipse, in which the motion may be counter-clockwise, and this broadens out into a circle with counter-clockwise motion which closes up again, and so on through the whole round of changes. This is ordinary light. If the orbit of the ether particle be fixed, we have polarized light. A polarized ray excites in the eye the ordinary sensation of light, but the interaction of rays of polarized light is distinct from the interaction between rays of ordinary light.

Suppose ordinary light to pass perpendicularly through a slice of a non-isotropic crystal cut parallel to a plane which contains two axes of different elasticity. Any force acting in a direction other than that of an axis cannot set up a vibration in such direction, for the force of restitution does not act in the direction of displacement. The motion is therefore resolved in the directions of the two axes, and two waves are propagated independently through the crystal, the vibration in one being a simple harmonic motion in the direction of the first axis, and in the other a similar motion in the direction of the other axis. Each ray in the crystal is a ray of rectilinearly polarized light. If one ray be stopped in its passage through the crystal, the other, on emergence, gives us a ray of rectilinearly polarized light travelling in air, the direction of vibration remaining after emergence just as it was fixed in the crystal. If another slice of crystal, similarly prepared so that only light vibrating in the direction of the one axis can pass, be placed in the path of the ray emerging from the first crystal, then, if the position of the second slice be similar to that of the first, the ray passes freely through. If the second slice be then rotated about the axis of the ray, less and less light passes through, until, when the slice has been rotated through a right angle, the light is completely stopped.

If both the rectilinearly polarized rays be allowed to emerge from a slice of crystal, they may compound together to produce a ray of elliptically or circularly polarized light. In this the excursion of the ether particle is a circle or ellipse in which the particle follows a fixed orbit.

In such waves of light the motion of the particle resembles the motion of the particle in a water wave, except that the plane of motion is at right angles to the direction in which the wave travels.

THE LIVERPOOL MEETING OF THE BRITISH ASSOCIATION.

LIVERPOOL is not an ideal city from an æsthetic point of view, but a considerable amount of scientific work has been carried on there in the past, and its University College is a great centre of "light and leading," with a professoriate of world-wide renown, actively engaged in the advancement of knowledge. The sixty-sixth annual meeting of the British Association could hardly be anything else but a success when held in a town owning so many men of scientific eminence. So far as numbers go, the meeting ranks high in the history of the Association. The largest meeting was held in Manchester in 1878, the total then being three thousand eight hundred and thirty-eight; Newcastle comes next with an attendance of three thousand three hundred and thirty-five in 1863, and the Liverpool meeting reached practically the same figure.

The scientific meetings of the Association were held this year in ten sections, viz.:—(A) Mathematical and Physical Science, (B) Chemistry, (C) Geology, (D) Zoology, (E) Geography, (F) Economic Science and Statistics, (G) Mechanical Science, (H) Anthropology, (I) Physiology, (K) Botany. The president of each of these sections delivered an address, and fifty or sixty papers were read and discussed in each section. Several evening lectures and discourses were also delivered during the meeting, so that it is hopeless for us to attempt to describe the work accomplished. All we can do is to give a statement of the general features of the meeting, and call attention to some of the most interesting points raised.

Sir Joseph Lister, the President of the Association this year, is also President of the Royal Society. The work for which his name is honoured is the antiseptic method of operating and treating wounds, and it constitutes the greatest

advance which surgery has ever made. Without dwelling unduly upon the investigations which led him to introduce antiseptic surgery, Sir Joseph Lister traced, in his presidential address, the bacteriological researches of Pasteur and others bearing upon it. Pasteur found that putrefaction was a fermentation caused by the growth of microbes, and the inference was that if a wound were treated with some substance which, without doing too serious mischief to the human tissues, would kill the microbes already contained in it, and prevent the access of others in the living state, putrefaction might be prevented. Acting upon this suggestion, Sir Joseph Lister began to apply carbolic acid to wounds, and was overjoyed to find that by so doing compound fractures healed as easily as simple fractures, in which the skin remains unbroken. More recent work has shown that it is not necessary to use carbolic acid, or any other irritating antiseptic, in the treatment of wounds. All that is required is scrupulous cleanliness. The surgeon washes his hands in disinfecting solution, and boils his instruments in water, or a weak solution of sodium carbonate, in order to free them from microbes. With the same end in view, his outer garments and the bandages are sterilized by being heated in a steam chamber. Everything likely to come into contact with a wound is carefully freed from germs, and nature is thus given the conditions to carry out undisturbed her best methods of repair. This change of operational technique does not, however, belittle the antiseptic method. Lister opened up the new era of surgery by showing that wounds would heal "by first intention" if kept entirely free from infection, and that is the principle now borne in mind by surgeons. The result is that, whereas in pre-antiseptic days a frightful proportion of patients succumbed to the inflammation of wounds, wound fevers, and hospital gangrene, at the present time scarcely a death is due to these sequelæ, however complicated the wound or difficult the operation.

The Physics Section of the Association was honoured by the presence of Prof. Lenard, whose name, though not so widely known as that of Prof. Röntgen, is held in just as high esteem in the scientific world. It was Prof. Lenard who showed that the kathode rays produced in high-vacuum tubes, and first studied by Dr. Crookes, could be brought out into the air by making a tube with an aluminium end opposite the disc from which the rays emanated. As Prof. Fitzgerald eloquently remarked in the discussion upon the paper in which Prof. Lenard described his researches, "he was the first to cross the Rubicon which separated us from the domain of what is now known as X-ray photography." Two years before the publication of Prof. Röntgen's startling results, Lenard had shown that kathode rays passed through opaque substances, and were capable afterwards of exciting a phosphorescent screen and of acting upon a photographic plate. A number of other papers on kathode rays, and Röntgen or X rays, were communicated to the section, and Prof. J. J. Thomson's address to the section was largely devoted to these subjects; but there was no consensus of opinion as to the nature of the rays, whether they were matter projected with high velocities or whether they were waves in the ether.

Prof. J. J. Thomson referred in his presidential address to the great improvement which has taken place in the teaching of physics in our public and secondary schools during the past ten years. At the same time he cautioned teachers and students against the temptation to take up too many subjects. He thought that physics was best begun with a course of mechanics, the students to do innumerable experiments of a simple kind leading to numerical results, and their work not to be shaped according to the dictates of the examinational fiend. The subject of scientific education came up also in the chemistry section, and the general opinion was that science should be more widely followed as a means of mental culture, in which aspect it can be made a subject of the greatest educational value. A long discussion took place on a paper by Sir Henry Roscoe on "Chemical Education in England and Germany," and the opinion was expressed that much more attention should be paid to scientific research both in the higher technical schools and in manufactories.

In his presidential address to the Section of Geology, Mr. J. E. Marr dealt at great length with the present state of knowledge of stratigraphical geology. Few papers of general interest were presented, and limits of space will only permit us to mention two of these—an account by the Coral Boring Committee of the unsuccessful attempt to bore through Funafuti, in the South Pacific, and a paper by Mr. Vaughan Cornish on the ripple-marks produced by the sea, streams, and wind. The address of Prof. E. B. Poulton to the Section of Zoology was of a somewhat disjointed character; but the chief point with which it dealt was the age of the earth, as estimated by geologists and physicists respectively. The Geographical Section was very largely attended, perhaps because most of the papers were descriptive of travels and explorations, and were illustrated by lantern slides. Africa and the Arctic were the chief themes brought before the section. To the Section of Mechanical Science very little of importance was communicated. Mr. C. Worby Beaumont gave an explanation of the apparently anomalous fractures of railway rails, and a valuable report was presented on the effect of wind and atmospheric pressure on the tides. A paper by Mr. W. H. Preece, giving the results of tests of a large number of glow lamps, must also be mentioned.

Mr. Arthur Evans dealt with "The Eastern Question in Anthropology" in his address to the Anthropological Section, and showed that "Eurafrica," in its widest sense, is the birthplace of the highest civilizations that the world has yet produced, and the mother country of its dominant peoples. Several very interesting discussions took place in the meetings of this section upon such subjects as the formation of an Ethnological Bureau, the origin of the knowledge of copper and iron in Europe, and the early civilization of the Mediterranean.

In the Section of Botany, Dr. D. H. Scott delivered an erudite presidential address on "The Present Position of Morphological Botany." The chief paper communicated to this section was on the ascent of water in trees, by Mr. Francis Darwin. Within the last few years this problem has entered upon a new stage of existence, and Mr. Darwin brought together the results of the researches which have led to this new development; the two questions considered being—(1) What is the path of the ascending water? (2) What are the forces which produce the rise?

Dr. W. H. Gaskell's address on "The Origin of the Vertebrates," delivered before the combined Sections of Physiology, Zoology, and Anthropology, provoked a large amount of discussion. The central pivot on which the theory put forward turns is the central nervous system, especially the brain region. The striking factor of the ascent of vertebrated animals, from the lowest fish to man, is the steady increase of the size of the central nervous system. However much other parts may suffer change or degradation, the brain remains intact, steadily increasing in power and complexity. The same law holds good in the invertebrate kingdom. These and many other considerations have led Dr. Gaskell to conclude that the central nervous system of the vertebrates must be considered as derived from the conjoined central nervous system and alimentary canal of an arthropod. The brain

is hollow, he holds, because it has grown around the old cephalic stomach, and our cerebral hemispheres are but modifications of the supraœsophageal ganglia of a scorpion. "The time is coming," he concluded, "and, indeed, has come, when the fetish worship of the hypoblast will give way to the acknowledgment that the soul of every individual is to be found in the brain, and not in the stomach; and that the true principle of evolution, without which no upward progress is possible, consists in the steady upward development of the central nervous system." The theory is very pretty, but unfortunately, as was pointed out at the meeting, there is very little actual evidence for it. No traces of the series of Limulus-like animals, having imperishable skeletons, are known to occur in the fossiliferous rocks. But whatever the ultimate decision may be as to the soundness (or otherwise) of Dr. Gaskell's conclusions, the hypothesis is startling enough to make zoologists and physiologists examine the foundations upon which other theories of the origin of vertebrates are based.

The most important object of the British Association is to bring together investigators in various branches of science for the mutual exchange of ideas. By this means a wider view is obtained, and directions in which researches can be profitably made are indicated. The recent meeting was not remarkable for the announcement of any great discoveries, and we venture to say that some of the presidential addresses were too diffuse and technical to be of interest to even the members of the sections in which they were read; but, at the same time, men of many branches of science mingled together, and went away more anxious than before to assist in the advancement of knowledge.

THE FACE OF THE SKY FOR NOVEMBER.

By HERBERT SADLER, F.R.A.S.

SUNSPOTS show a very gradual increase in number and size. Conveniently observable minima of Algol occur at 9h. 33m. P.M. on the **13th**, and at 6h. 22m. P.M. on the **16th**. A maximum of the remarkable variable *o* (Mira) Ceti is due on the **3rd**.

Mercury is visible as a morning star during the first half of the month. He rises on the **1st** at 5h. 20m. A.M., or 1h. 36m. before the Sun, with a southern declination of 7° 21′, and an apparent diameter of $5\frac{1}{2}''$, $\frac{83}{100}$ths of the disc being illuminated. On the **6th** he rises at 5h. 45m. A.M., or 1h. 21m. before the Sun, with a southern declination of 10° 29′, and an apparent diameter of $5\frac{1}{4}''$, $\frac{9}{10}$ths of the disc being illuminated. On the **11th** he rises at 6h. 13m. A.M., or about one hour before the Sun, with a southern declination of 14° 49′, and an apparent diameter of 5″, $\frac{96}{100}$ths of the disc being illuminated. After this he approaches the Sun too closely to be visible. He describes a direct path in Virgo to the confines of Libra. He is in superior conjunction with the Sun on the **28th**.

Venus is an evening star, but owing to her great southern declination is by no means well situated for observation. On the **1st** she sets at 5h. 45m. P.M., or about one hour and a quarter after the Sun, with a southern declination of 22° 57′, and an apparent diameter of 12″, $\frac{87}{100}$ths of the disc being illuminated.

Mars is now the most conspicuous object in the evening sky. He rises on the **1st** at 6h. 47m. P.M., with a northern declination of 24° 13′, and an apparent diameter of 15″, the phasis on the preceding limb amounting to 1″. On the **5th** he rises at 6h. 30m. P.M., with a northern declination of 24° 24′, and an apparent diameter of $15\frac{1}{4}''$. On the **11th** he rises at 6h. P.M., with a northern declination of 24° 41′, and an apparent diameter of $15\frac{3}{4}''$. On the **15th** he rises at 5h. 42m. P.M., with a northern declination of 24° 53′, and an apparent diameter of $16\frac{1}{4}''$. On the **25th** he rises at 4h. 48m. P.M., with a northern declination of 25° 19′, and an apparent diameter of $16\frac{3}{4}''$. On the **30th** he rises at 4h. 18m. P.M., or 25m. after sunset, with a northern declination of 25° 29′, and an apparent diameter of $17\frac{1}{4}''$. During the month he describes a retrograde path in Taurus.

Jupiter does not rise till 11h. 13m. P.M. on the last day of the month, and Saturn and Uranus are, for the observer's purposes, invisible.

Neptune is an evening star, rising on the **1st** at 6h. 26m. P.M., with a northern declination of 21° 38′, and an apparent diameter of 2·6″. On the **30th** he rises at 4h. 28m. P.M., with a northern declination of 21° 34′. He describes a very short retrograde path in Taurus during November.

November is a very favourable month for shooting stars. The most marked display are the Leonids on November **13th** and **14th**, the radiant point being in R.A. 10h., and northern declination 23°. The radiant point rises at about 10h. 15m. P.M. The Andromedes occur on the **27th**, the radiant point being in R.A. 1h. 40m., and northern declination 43°.

The Moon is new at 7h. 27m. A.M. on the 5th; enters her first quarter at 5h. 41m. A.M. on the 12th; is full at 10h. 25m. A.M. on the 20th; and enters her last quarter at 2h. 44m. A.M. on the 28th.

Chess Column.

By C. D. LOCOCK, B.A.Oxon.

Communications for this column should be addressed to C. D. LOCOCK, Burwash, Sussex, and posted on or before the 10th of each month.

Solutions of October Problems.

No. 1.

(J. K. Macmeikan.)

1. Q to R8, and mates next move.

[This is the first published problem of this promising young composer.]

No. 2.

(A. G. Fellows.)

Key move.—1. Q to QBsq.

If 1. . . . Kt or P moves, 2. Kt to B5ch, etc.
1. . . . K to Q6, 2. Kt(B2) to Kt4ch, etc.
1. . . . K to B4, 2. Q to R6, etc.

CORRECT SOLUTIONS of both problems received from Alpha, H. Le Jeune, G. A. F. (Brentwood), L. Pfungst, J. T. Blakemore, A Norseman.

Of No. 1 only from H. S. Brandreth, A. S. Coulter, G. G. Beazley, J. M'Robert, W. Clugston, W. Willby, H. W. Elcum, G. J. Newbegin, E. C. Willis.

Various incorrect solutions have been sent for No. 2, which has been greatly admired by those who solved it correctly. The favourite error has been 1. K to Kt6, which seems to be met only by 1. . . . P to Q5, 2. Kt(R6) to Kt4, Kt to Kt4.

A. S. Coulter.—After 1. Q to Ksq ch, K to Q6, there is no mate in two more moves.

H. S. Brandreth.—1. Q to QKtsq will not solve No. 2. The King finds safety at KB3.

Mrs. L. Strange.—Your card evidently applies to the September Number. Solutions should be sent in by the 12th of the month. The October Number will show you

that your solution is correct, though not the author's intention.

J. T. Blakemore.—Shall be glad to receive the three-mover.

H. W. Elcum.—Your criticisms are much to the point.

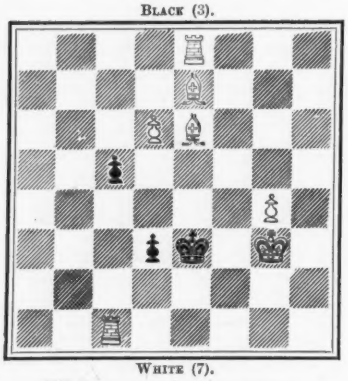
W. Clugston.—Many thanks for the enclosures. Your two-mover is a great improvement in strategy on the rather elementary set received last month. At the same time it seems capable of further simplification, and, furthermore, in urgent need of it, the variety being hardly proportionate to the large force employed. To take one point only, why not remove the Pawn which guards the Black Knight? The omission would leave two excellent tries by Q × Kt and Q to R2, both threatening immediate mates, to which Black has in each case only one defence. The thirteen-variation problem is excellent, as you say, though these "flights of Rooks" are an old theme. What is the solution of Mr. Loyd's problem No. 37?

PROBLEMS.

By Eugene Henry.

No. 1.

BLACK (3).

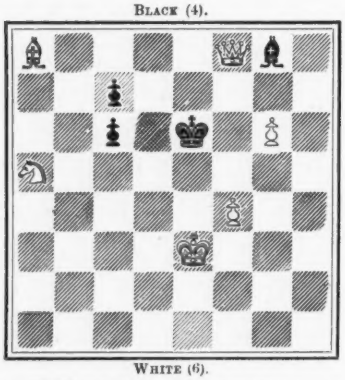


WHITE (7).

White mates in two moves.

No. 2.

BLACK (4).



WHITE (6).

White mates in two moves.

CHESS INTELLIGENCE.

We notice with regret an announcement in the *Chess Monthly* to the effect that that magazine closes its present career with the current number. Mr. Hoffer has edited the *Chess Monthly* for seventeen years; first in conjunction with Dr. Zukertort, and since his death by himself. Competition with the now numerous chess columns in the daily press, and lack of time for so arduous an undertaking, are the reasons given for what, we are glad to see, may prove only a break in continuity. The feature of the present double number is a diagram by Mr. W. H. Cubison, illustrating the "Knights' Tour" on a board of 4096 squares; truly a marvellous piece of patient work!

An International Tournament was begun at Buda-Pesth in the first week of October. The competitors were thirteen in number, viz.:—Albin, Marco, and Schlechter of Vienna, Dr. Tarrasch of Nuremburg, Herr Walbrodt of Berlin, Mr. Pillsbury of America, M. Tchigorin of St. Petersburg, Herr Winawer of Warsaw, Herren Maroczy, Charousek, and Popiel of Hungary, and M. Janowski of Paris.

At the time of writing, Herr Winawer, who seems, after the practice he had at Nuremburg, to have recovered his old form, has a clear lead. Dr. Tarrasch again started disastrously, his fate now in three successive tournaments. Messrs. Lasker and Steinitz were expected to compete, but evidently preferred to reserve themselves for their match, which is announced to begin early this month.

We regret to announce the death of Mr. E. Freeborough, of Hull, for many years one of our leading amateur players and analysts. He was a valued contributor to the *British Chess Magazine*, and the author of numerous works on the theory of the chess openings and endings. In conjunction with Mr. Ranken he compiled the well-known "Chess Openings, Ancient and Modern."

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TWO PLATES.—1. English Coins. 2. Clavius and his Neighbours.

EXTRACT FROM A LECTURE ON "FOODS," BY DR. ANDREW WILSON.—"The consumption of cocoa happily increases year by year. I say 'happily,' because, as tea and coffee are not foods, while cocoa is a true food, any increase in the national nutrition means an increase in the national prosperity. Winter, besides, is close upon us, and I advise those who are susceptible to colds to fortify themselves against chill by attention to their food. The easiest way of effecting this end for many is to substitute cocoa (Epps's being the most nutritious) for tea and coffee." – [*Advt.*]

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